

NTPC Limited

(A Government of India Enterprise)



LOT 1A PROJECTS

**PART – B
(DETAILED TECHNICAL SPECIFICATION)**

**SUB-SECTION-II-E
(ELECTRICAL SYSTEM)**

SECTION – VI

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

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

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-II-E (ELECTRICAL SYSTEM)

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

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

SUB-SECTION-II-E1

GENERAL ELECTRICAL SPECIFICATION

**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			
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% shall be considered. The equipment shall operate in a highly polluted environment. However, for equipment in air conditioned areas, design ambient temperature shall be 35 deg.C, if 2x100% air conditioning system is provided.			
1.02.00	All equipment shall be suitable for rated frequency of 50Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.			
1.03.00	Contractor shall provide fully compatible electrical system, equipment, accessories and services for the entire station/plant in his scope as well as those specifically required by the Employer.			
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	The auxiliary AC voltage supply arrangement shall have 11 kV, 3.3KV and 415V systems. It shall be designed to limit voltage variations as given below under worst operating condition:			
	a)	11KV/3.3KV (MV)	+/- 6%	
	b)	415 V/240 V	+/- 10%	
	c)	220V/110V	-15% to +10%	
1.06.00	The voltage level for motors shall be as follows:			
	a)	Upto 0.2 KW	:	Single phase 240V AC / 3 phase 415V AC
	b)	Above 0.2 KW and upto 200 KW	:	3 phase, 415V AC
	c)	Above 200 KW and upto 1500 KW	:	3 phase, 3.3 kV AC
	d)	Above 1500 KW	:	11 kV
	The bidder may adopt 415V/3.3 KV for the drives rated in the range of 160-210 KW.			
	The voltage rating of the drives indicated above is for basic guideline. Minor variations in above can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.			
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-II-E1 GENERAL ELECTRICAL SPECIFICATION
PAGE 1 OF 7				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.07.00	Voltage rating for special purpose motors viz, VFD shall be as per manufacturer's standard.			
1.08.00	The preferred AC control supply voltage shall be 110V for all 415 V non breaker controlled feeders. Control supply voltages other than above may be offered by bidder based on the bidder's standard proven practice.			
1.09.00	The designed fault levels for various voltage levels shall be restricted to the following values: 11 kV- 40 kA rms for 1 sec 3.3 kV- 40 kA rms for 1 sec 415 V- 50kA rms for 1 sec			
1.10.00	The Contractor shall furnish calculations of maximum loading and fault levels under the most onerous conditions for the various equipment/systems as defined elsewhere in the specification to prove adequacy of their parameters. In case any equipment or system is found to be inadequate, it shall be changed/ modified without any additional liability to the Employer.			
1.11.00	Transformer voltage ratios, taps, impedances and tolerances thereon, shall be so optimized so that the auxiliary system voltages under various loading conditions are always within permissible limits and equipment are not subjected to unacceptable voltages during operation and starting of motors. The vector groups of the transformers shall be so selected that all the buses of particular voltage level have same vector within the plant.			
1.12.00	In fire hazardous areas like gas/ liquid fuel storage/ handling areas, lighting fixtures, switchgears shall be flame proof.			
1.13.00	The responsibility of coordination with electrical agencies /TAC/Pollution control board and obtaining all necessary clearances shall be of the contractor.			
2.00.00	Provenness Criteria			
2.01.00	Provenness of the Equipment, system, being offered by the bidder should satisfy the criteria Indicated in the "Provenness criteria" indicated elsewhere in the specification.			
	Sizing & Design			
	Auxiliary Transformers			
	All the transformers shall be sized based on the maximum load expected to be fed by them under most onerous conditions or as per the rating indicated in the Electrical Single Line Diagram.			
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-II-E1 GENERAL ELECTRICAL SPECIFICATION	PAGE 2 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.04.00	All switchboards shall be of double front, draw out, metal enclosed, indoor, floor-mounted, free-standing type of bolted design. Entire bus bar system shall be insulated with PVC sleeves. Cable terminations located in cable alley shall be designed to meet the Form IVb (as per IEC 61439) for safety purpose. All ACDBs, DCDBs, Solenoid Valve DBs and MCCs located on travelling trippers shall be of Fixed Module type. All 415V Circuit breaker modules and other MCC modules shall be fully draw out type. The Circuit Breakers / Contactors shall be of air break type & should conform to the requirements of IS / IEC 60947. MCCB shall be provided for 100A, 125A, 160A, 250A & 400A supply feeders. The motor feeders for 110kW & above shall be Air Circuit Breaker controlled. For 415V system, busduct assemblies shall be used for incoming connection from transformers to the switchboard and interconnecting sections between switchboards wherever transformer rating is 1000KVA or above.			
	Integration with Employer’s Switchgear SCADA			
	All MV & LV circuit breakers shall be provided with Communicable Numerical Relays complying with IEC-61850 as specified in Sub-section II-E-09. These relays shall be integrated with Employer's Switchgear SCADA through Ethernet switches (to be supplied by Employer) mounted on each switchgear. The circuit breaker will normally be controlled from remote control panels (DDCMIS) through closing and shunt trip coils. The control of the breakers shall also be possible from the Employer’s Switchgear SCADA system.			
2.05.00	Control Philosophy			
	The Control Philosophy shall be as follows: (a) All the 11 KV/ 3.3 KV & LT Incomers, Ties , Bus couplers, Transformer feeders shall be controlled from Switchgear SCADA and also from DDCMIS. (b) The motor feeders shall be controlled from the DDCMIS only..			
2.06.00	Cables and Bus Ducts			
	The minimum rating of cable/ bus ducts shall meet the following criteria: All the cables and bus ducts feeding switchboards from transformers shall be sized based on transformer rating and considering the maximum negative voltage variations envisaged in the specifications. All the cables and bus ducts feeding transformers shall be sized based on current ratings of transformer at the minimum voltage tap of the transformer. All other cables/bus-ducts shall be sized based on the			
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-II-E1 GENERAL ELECTRICAL SPECIFICATION	PAGE 4 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
2.07.00	load demand under most onerous conditions. Cables shall be selected to so as to limit maximum voltage drop at equipment terminals during normal operation and starting conditions well within permissible values. Cables shall be derated for the site ambient and ground temperatures, grouping and soil resistivity and cable laying configuration. All HT cables shall be of unearthed grade. The bidder shall furnish detailed cable selection/sizing criteria for Employer's approval. Earthing & Lightning Protection System The earthing system for plant shall be designed for a life expectancy of at least forty (40) years, for a system fault current of 50 kA for 1.0 sec. The minimum rate of corrosion of steel for selection of earthing conductor shall be 0.12mm per year. Grounding and lightning protection for the entire plant areas or buildings covered in the specification shall be provided in accordance with IS 3043, IS 2309, IEEE 80 and IEEE 665.		
	2.08.00 D.C. Systems Complete DC system, comprising of batteries, battery charges, relays, contactors, timers etc shall be suitable for continuous operation at the maximum continuous float voltage including suitable temperature correction factors. The battery sizing shall be done based on different types of continuous and intermittent loads including motor starting (wherever applicable) under complete blackout condition, for the duration specified so as to meet the system requirement (30 minutes minimum). All intermittent loads shall be considered with minimum 1 minute duration. The battery shall be sized considering a minimum electrolyte temperature of 15Deg C along with temperature correction factors as per relevant standard. An ageing factor of 1.25 shall be considered. The no. of cells and end cell voltage shall be considered based on the minimum and maximum voltage window and cable drop etc. as per system requirement. Each system shall comprise of two nos. of batteries and two nos. of float-cum-boost chargers each rated for 100% capacity. DC scheme shall ensure that each critical consumer is fed from two different bus sections. DCDBs shall provide adequate number of feeders on each section. Boost/ fast charging time shall be as per worst operating condition and would satisfy technical requirements recommended by battery manufacturer. Each battery charger must be capable of supplying all the continuous D.C. loads (fed through both section of DCDB) plus the trickle charging current of both the batteries. In addition, each charger must have sufficient surplus capacity for running of the largest D.C auxiliary so that the battery is not drained during testing of the same. Battery charger should		
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-II-E1 GENERAL ELECTRICAL SPECIFICATION PAGE 5 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS																				
5.00.00	NOT USED																				
6.00.00	Neutral Grounding																				
6. 01.00	11KV/3.3KV system earthing shall be low resistance earthed type to limit earth fault current to 600A. The resistor shall be rated to carry this current at least for 10 seconds.																				
6.02.00	Neutrals of all LT Transformers (415V) shall be solidly earthed through bolted links.																				
6.03.00	220V DC/110V DC system shall be kept ungrounded.																				
6.04.00	Diesel generator (if applicable) shall also be kept ungrounded (earthing through PT).																				
7.00.00	FAULT LEVEL Equipment through fault withstand capabilities under worst operating conditions duly taking into account negative tolerances on transformer and maximum fault levels of source etc. shall be as follows : <table><tr><td>i)</td><td>All transformers</td><td>- 2 seconds</td></tr><tr><td>ii)</td><td>11 kV/3.3 KV busduct</td><td>- 1 second</td></tr><tr><td>iii)</td><td>Switchgears</td><td>- 1 second</td></tr><tr><td>iv)</td><td>Cables to the feeders protected by breakers</td><td>Main protection fault clearing time with 0.12 seconds minimum</td></tr><tr><td>v)</td><td>Cables of all other feeders</td><td>As per fuse operating time</td></tr><tr><td>vi)</td><td>11KV & 3.3KV cable screen</td><td>- 2 seconds for the adopted ground fault current</td></tr></table>			i)	All transformers	- 2 seconds	ii)	11 kV/3.3 KV busduct	- 1 second	iii)	Switchgears	- 1 second	iv)	Cables to the feeders protected by breakers	Main protection fault clearing time with 0.12 seconds minimum	v)	Cables of all other feeders	As per fuse operating time	vi)	11KV & 3.3KV cable screen	- 2 seconds for the adopted ground fault current
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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-II-E1 GENERAL ELECTRICAL SPECIFICATION																		
PAGE 7 OF 7																					

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			एन टी पी सी 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		SUB SECTION-II-E2 MOTORS
				PAGE 1 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.00.00	TYPE			
3.01.00	AC Motors: a) Squirrel cage induction motor suitable for direct-on-line starting. b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30. c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement. d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.			
3.02.00	DC Motors	Shunt wound.		
4.00.00	RATING			
	(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor. (b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.			
5.00.00	TEMPERATURE RISE			
	Air cooled motors			
	70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.			
	Water cooled			
	80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.			
6.00.00	OPERATIONAL REQUIREMENTS			
6.01.00	Starting Time			
6.01.01	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.			
6.01.02	For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.			
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	SUB SECTION-II-E2 MOTORS	PAGE 2 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	SUB SECTION-II-E2 MOTORS
			PAGE 3 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
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	SUB SECTION-II-E2 MOTORS
			PAGE 4 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC																
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): <table><tr><td>(a) From 50KW & upto 110KW</td><td>:</td><td>11.0</td></tr><tr><td>(b) From 110 KW & upto 200 KW</td><td>:</td><td>9.0</td></tr><tr><td>(c) Above 200 KW & upto 1000KW</td><td>:</td><td>10.0</td></tr><tr><td>(d) From 1001KW & upto 4000KW</td><td>:</td><td>9.0</td></tr><tr><td>(e) Above 4000KW</td><td>:</td><td>6 to 6.5</td></tr></table>	(a) From 50KW & upto 110KW	:	11.0	(b) From 110 KW & upto 200 KW	:	9.0	(c) Above 200 KW & upto 1000KW	:	10.0	(d) From 1001KW & upto 4000KW	:	9.0	(e) Above 4000KW	:	6 to 6.5		
(a) From 50KW & upto 110KW	:	11.0																
(b) From 110 KW & upto 200 KW	:	9.0																
(c) Above 200 KW & upto 1000KW	:	10.0																
(d) From 1001KW & upto 4000KW	:	9.0																
(e) Above 4000KW	:	6 to 6.5																
10.00.00	TYPE TEST																	
10.01.00	HT MOTORS																	
10.01.01	The Contactor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Contactor shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's engineer.																	
10.01.02	The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the Contactor. The Contactor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different 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	SUB SECTION-II-E2 MOTORS															
			PAGE 5 OF 9															

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
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	SUB SECTION-II-E2 MOTORS	PAGE 6 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	(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	SUB SECTION-II-E2 MOTORS	PAGE 7 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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	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><th>Motor MCR in KW of</th><th>Minimum distance between centre stud and gland plate in mm As per manufacturer's practice.</th></tr><tr><td>UP to 3 KW</td><td></td></tr><tr><td>Above 3 KW - upto 7 KW</td><td>85</td></tr><tr><td>Above 7 KW - upto 13 KW</td><td>115</td></tr><tr><td>Above 13 KW - upto 24 KW</td><td>167</td></tr><tr><td>Above 24 KW - upto 37 KW</td><td>196</td></tr><tr><td>Above 37 KW - upto 55 KW</td><td>249</td></tr><tr><td>Above 55 KW - upto 90 KW</td><td>277</td></tr><tr><td>Above 90 KW - upto 125 KW</td><td>331</td></tr><tr><td>Above 125 KW-upto 200 KW</td><td>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><th>Motor MCR in KW</th><th>Clearance</th></tr><tr><td>UP to 110 KW</td><td>10mm</td></tr><tr><td>Above 110 KW and upto 150 KW</td><td>12.5mm</td></tr><tr><td>Above 150 KW</td><td>19mm</td></tr></table>				Motor MCR in KW 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	SUB SECTION-II-E2 MOTORS	PAGE 9 OF 9																													

SUB-SECTION-II-E3

MEDIUM VOLTAGE BUS DUCTS

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

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

1.00.00	CODES & STANDARDS
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1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards and codes.
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STANDARD	DESCRIPTION
IS:2062	Steel for General Purpose specification.
IS:737	Specification for wrought aluminum and aluminum alloys, sheet and strip (for engineering purpose).
IS:800	Code of practice for use of structural steel in general building construction.
IS:1367 PART-13	Hot dip galvanised coatings on threaded fasteners.
IS:2099	Bushing for A.C. voltage above 1000 volts.
IS:13947 PART-1	Low voltage switchgear & controlgear
IS:2544	Porcelain post Insulators for system with normal voltage greater than 1000 volts.
IS:2633	Methods of testing uniformity of coating on zinc coated articles
IS:4759	Hot dip zinc coating on structural steel and allied products.
IS:5082	Specification for wrought Aluminum alloys bars, rods, tubes and sections for electrical purposes.
IS:8084 Updated upto:1992	Interconnecting bus bars for A.C. voltage above 1KV upto and including 36KV.
ANSI C37:20	Switchgear Assemblies including Metal enclosed Bus.

1.02.00	Equipment complying with other internationally accepted standards such as IEC, BS, ANSI, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standards adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
1.03.00	Installation work shall also conform to Indian Electricity Act and Indian Electricity Rules as amended upto date.		
2.00.00	GENERAL TECHNICAL REQUIREMENTS		
2.01.00	The busduct will serve as interconnections between transformers and switchgears, and between switchgears. The technical parameters of busduct (11KV & 3.3 KV) are enclosed at Annexure-A to this section.		
2.02.00	The busduct will be installed partially indoors and partially outdoors in a hot, humid and tropical atmosphere.		
2.03.00	The maximum temperature of the bus conductor and enclosure shall be as defined in the technical parameters when operating at maximum ambient temperature and carrying rated current continuously. For outdoor portions the effect of solar radiation shall also be considered. The bidder shall furnish calculation for temperature rise taking effect of solar radiation into consideration.		
2.04.00	The busduct shall be capable of withstanding the mechanical forces and thermal effects of three phase short circuit currents, mentioned in the technical parameters at ANNEXURE-A, without any damage, deformation or deterioration of material.		
3.00.00	EQUIPMENT DESCRIPTION		
3.01.00	Bus Conductor		
3.01.01	The bus conductor shall be of high conductivity aluminum alloy, adequately supported on insulators to withstand dynamic stress due to the specified short circuit current, without permanent deformation.		
3.01.02	Flexible joints shall be provided between busduct sections to take care of expansion and contraction, wherever deemed necessary by the Bidder, for temperature variations between 0 Deg. C. and that achieved during a short circuit after full load operation at 50 Deg. C. ambient. Flexible connection shall also be provided for termination at each transformer and switchgear end. Details of transformer bushings and switchgear terminals for owners scope (if any) shall be intimated to the successful bidder during the detailed engineering stage. Clearances provided by removable connections shall be adequate for independently testing the equipment being connected by these.		
3.01.03	Adjacent sections of bus conductors shall be welded or bolted. Welded joints shall be preferred. Welding procedure shall be subject to Employer's approval. Bolted joints shall preferably be silver plated. Non-silver plated		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E3 Medium Voltage Busducts
			PAGE 2 OF 11

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	joints shall be thoroughly cleaned and applied with non-oxide grease immediately prior to making the joints.			
3.01.04	All bus joints and connections whether welded or bolted shall be so made that their resistance does not exceed the resistance of an equivalent length of bus of same size and the temperature rise on them shall be within the guaranteed values.			
3.02.00	Enclosure			
3.02.01	The three phases of bus conductors shall be enclosed in weather and vermin proof, dust-tight enclosure made of Aluminum alloy. The shape of the enclosure shall preferably be rectangular. All horizontal runs of the busduct shall have a suitably sloped enclosure top to prevent retention of water. The busduct enclosure shall be phase segregated type.			
3.02.02	Busduct enclosure shall have a degree of protection of IP-5X in accordance with IS:13947, pt.- I. Busduct shall also meet the requirements for water tightness test & air leakage test.			
3.02.03	The busduct enclosure shall have expansion bellows to take care of temperature changes and vibrations. Flexible joints shall be provided in enclosures at all points where the busduct terminates at equipment to withstand vibration expansion/contraction and at suitable intervals in any straight run of busduct where expansion and contraction would otherwise result in stresses in the supporting structures.			
3.02.04	Inspection openings/split covers shall be provided to allow easy access for installation, inspection, replacement or repairs of the insulators, bus connection and terminations. The inspection openings/split covers, enclosure joints, termination etc. shall have reliable sealing arrangement with neoprene/rubber gaskets to prevent dust & water entry.			
3.02.05	At each enclosure joint in the outdoor portion of the busduct run, a suitable rain hood shall be provided for additional protection against water ingress. The gaskets shall preferably of the jointless type, in case of a joint, the same shall be at bottom.			
3.02.06	Seal-off bushings complete with wall frames and support plates shall be provided where the busduct crosses from indoor to outdoor portion. The seals are to prevent exchange of air between indoor and out-door portions of the busducts. Seal off bushings shall also be provided on each busduct termination on a switchgear. Where busduct cross building internal wall only wall frame assemblies 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(1A)-2	SUB SECTION-II-E3 Medium Voltage Busducts	PAGE 3 OF 11

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.02.07	The busduct enclosure shall be adequately rigid and stiffeners shall be provided wherever necessary. Minimum enclosure thickness shall be 3 mm.			
3.02.08	Phase barriers made of aluminum alloy shall be provided in the busduct for phase segregation. Minimum thickness shall be 3 mm.			
3.02.09	Opening covered with louvers backed up with removable dust filters and silica gel breather shall be provided at indoor & outdoor potion of busduct to enable the busduct enclosure to breathe in a manner so that possibility of condensation and ingress of dust is minimised.			
3.02.10	Filtered drain plugs for drainage of condensate and seepage water if any shall be provided at the lowest points and at such location where accumulation of condensate can be expected. These drain plugs shall be located at a suitable place convenient to operate.			
3.03.00	Insulators			
3.03.01	Bus support insulators shall be interchangeable, high creep, high strength and made of fine glazed solid porcelain manufactured by wet process or high strength cast resin insulators.			
3.03.02	The insulators shall be designed and mounted in such a manner so as to facilitate easy inspection, removal and replacement without disturbing the conductor.			
3.03.03	The conductors shall be fixed to the insulator so to permit differential expansion and contraction with the enclosure without overstressing the insulators. The insulators shall be designed to safely withstand the maximum possible short circuit forces.			
3.03.04	All bolts, nuts and lock washers used in the bus assembly shall be high tensile steel, plated for corrosion resistance. Spring washers or equivalent means shall be used for ensuring good contact pressure under all operating conditions. All bolts shall be tightened using properly calibrated torque spanner by applying the recommended torque.			
3.04.00	Space Heaters			
3.04.01	The busduct shall be provided with adequate number of thermostatically controlled space heaters of adequate capacity to maintain the internal temperature above the dew point to prevent moisture condensation within the busduct. Space heaters shall be rated for 240V, single phase, 50Hz AC supply.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E3 Medium Voltage Busducts
PAGE 4 OF 11				

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.04.02	The space heaters and thermostats shall be wired upto terminals in suitably located terminal boxes to be provided by the contractor. The space heater wiring inside the busduct enclosure shall be done with high temp. resistant cables as the ambient temperature existing inside the busduct enclosure may vary from 80 deg.C to 90 deg.C. The minimum conductor size of space heater wiring shall be 2.5 sq.mm. A separate ON/OFF switch shall be provided for controlling the space heaters of each busduct in the marshalling box located at convenient height. One number single phase 240V power supply at the marshalling box for complete run of every busduct shall be provided by employer. All cabling between space heaters/thermostats and marshalling box in the run of busduct shall be supplied and erected by the contractor. Cable entry points to the busduct shall be sealed properly by providing suitable glands.			
3.05.00	Busduct Support			
3.05.01	Bidder shall provided necessary support structures and all hardware structures to support the busduct all along its route.			
3.05.02	The design of the support structure shall conform to IS:800. Suitable members shall be provided along the outdoor support structure for supporting cable trays (if any).			
3.05.03	In the indoor portions, the busduct shall be supported from floor / roof beams or steel inserts in upper floors. In the outdoor potions, they shall be supported from the ground, by means of steel structures, unless indicated otherwise in the specification drawings.			
3.05.04	All steel structures required for busduct support shall be hot dip galvanised and shall be strong enough to cater for various static and dynamic loading such as weight of busduct, short circuit forces, wind load, thermal expansion and contraction etc.			
3.05.05	All hardware shall be galvanised or cadmium plated.			
3.06.00	Earthing			
3.06.01	A continuous 65 x 8 mm galvanised mild steel earth bar shall be provided along the entire run of each busduct. Each section of the busduct enclosure shall be bonded to this earth bar at least at both ends of the enclosure. The earth bar shall be connected to the main earthing system at its two ends by the contractor.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E3 Medium Voltage Busducts	PAGE 5 OF 11

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.07.00	Connection and Termination			
3.07.01	All matching flanges, flexible connections, adopter boxes, gaskets, fittings, hardware and support required for termination of the busduct at transformer and switchgear ends, shall be provided by the Bidder.			
3.08.00	The bidder shall co-ordinate, through the Employer/Project Manager, with the suppliers of the transformers and switchgears (if any), regarding the termination details.			
3.08.01	Flexible connections at equipment termination shall be able to take care of misalignment upto 25 mm in all directions.			
3.08.02	The equipment terminal connections shall be easily accessible and shall provide sufficient air gap for safe isolation of equipment during testing.			
3.08.03	All hardware used in the MV Busduct shall be non-magnetic.			
3.08.04	Suitable bi-metallic connectors shall be provided wherever the material of bus conductor and equipment terminals are different.			
3.09.00	Paint and Finish			
3.09.01	All surfaces shall be thoroughly cleaned and cleared of all blemishes. De-rusting, degreasing etc. shall be done before painting or galvanising. Paints shall be carefully selected to withstand heat and weather conditions. The paints shall not scale off or crinkle or get removed by abrasion due to normal handling.			
3.09.02	The paints shall consist of one coat of primer followed by one anti-corrosive coat for steel structures. Finally two coast of finishing paint shall be given. The final colour shade shall be BLUE RAL: 5012.			
3.09.03	The bus conductor and the inside surface of the enclosure shall be treated with matt black paint for efficient heat dissipation.			
3.09.04	Sufficient quantity of all paints required for touching up at site, shall be provided.			
4.00.00	TYPE & ROUTINE TESTS			
4.01.01	All equipments to be supplied shall be of type tested design. During detailed engineering, 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			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E3 Medium Voltage Busducts	PAGE 6 OF 11

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	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.			
4.01.02	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client /Employers representative and submit the reports for approval.			
4.01.03	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.			
4.01.04	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.			
4.01.00	LIST OF TYPE TESTS			
4.01.01	Medium voltage Busduct			
	The following type tests reports to be submitted on each rating of bus ducts: (a.) Heat run test (the set up shall include 3 phase straight run, 90 deg. bend, set of flexible connection of each type, and necessary inspection covers). (b.) Short circuit withstand test (set up same as for heat run). (c.) Impulse withstand test (set up shall include typical X-section with flexible connections, 90 degree bend, seal off bushing and inspection cover. (d.) Air leakage rate and Water tightness test (set up shall include inspection cover, flanged joint and bellow).			
4.02.00	ROUTINE TESTS			
	Routine tests shall be conducted at manufactures works on each busduct and all other components as per relevant Indian Standards & Quality Assurance Sub-section.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E3 Medium Voltage Busducts	PAGE 7 OF 11

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Also, Radiography Test (RT) shall be conducted as follow: 1. 10% on Flexible conductor			
5.00.00	INSTALLATION CHECKS			
5.01.00	The contractor shall carry out the following tests at site. (a.) 10% radiography and 100% DP test on all site welded joints of busbar and enclosure (if applicable). (b.) Mili volt drop. (c.) Insulation resistant measurement of equipment and all wiring.			
6.00.00	COMMISSIONING CHECKS			
6.01.00	The contractor shall carry out the following commissioning tests and checks at site. (a.) Power frequency voltage withstand test. (b.) Water tightness test on outdoor portion of busduct. (C) Power frequency voltage withstand test			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E3 Medium Voltage Busducts	PAGE 8 OF 11

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	ANNEXURE-A			
S.No.	PARAMETER	11KV BUSDUCT	3.3KV BUSDUCT	
(1.)	Number of phase	3	3	
(2.)	Frequency	50 Hz	50 Hz	
(3.)	Nominal voltage	11KV	3.3 KV	
(4.)	Highest system voltage	12KV	3.6 KV	
(5.)	One minute power Frequency Withstand voltage (Dry & wet)	35KV	21KV	
(6.)	Impulse voltage withstand value with 1.2/50 microsecond wave shape	75KV	40 KV	
(7.)	Continuous current rating at 50 ⁰ C ambient	As per system requirement	As per system requirement.	
(8.)	Short time current rating for 1 second	40KA (rms)	40KA (rms)	
(9.)	Dynamic current withstand rating.	100 KA(peak)		
(10.)	Type of Cooling	Natural		
(11.)	Type of Bus enclosure	Phase segregated		
(12.)	Service	Indoor/Outdoor		
(13.)	Minimum clearance of live parts in Air	Shall be as per type tested set up piece		
	a)Phase to phase	-do-		
	b)Phase to earth	-do-		
(14.)	Busbar Material	Aluminum alloy		
(15.)	Enclosure & Partition Material	Aluminum alloy		
(16.)	Minimum thickness of enclosure	3 mm		
(17.)	Minimum thickness of partition	3 mm		
(18.)	Insulators & bushings			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E3 Medium Voltage Busducts	PAGE 9 OF 11

CLAUSE NO.		TECHNICAL REQUIREMENTS			
S.No.		PARAMETER	11KV BUSDUCT	3.3KV BUSDUCT	
		a) Rated Voltage	12 KV	3.6 KV	
		b) One min power frequency withstand Voltage			
		(i) Dry	35 KV (rms)	21KV(rms)	
		(ii) Wet	35 KV (rms)	21KV(rms)	
		c) Impulse Voltage withstand Value with 1.2/50 micro sec wave shape.	75 KV	40KV	
		d) Minimum Creepage Distance	240 mm	130 mm	
		e) Material of Insulator/Bushing	Porcelain/Cast Resin		
(19.)		Material of earthing conductor mild steel	65 mm x 8mm Galvanized		
(20.)		Design ambient Temperature	50°C		
(21.)		Maximum temperature rise over an ambient of 50 ⁰ C when carrying the rated current continuously (with effect of solar radiation)			
		a) Bus Conductor			
			For Indoor Portion	For Outdoor Portion	
		(i) Bolted Joints (Plain or tinned)	40°C	32.5°C	
		(ii) Bolted Joints (silver plated)	55°C	47.5°C	
		b) Busduct Enclosure	30°C	22.5°C	



SUB-SECTION-II-E4

LT POWER CABLES

**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																									
1.00.00	CODES & STANDARDS																									
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes: <table><tr><td>IS :1554 - I</td><td>PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.</td></tr><tr><td>IS : 3961</td><td>Recommended current ratings for cables</td></tr><tr><td>IS : 3975</td><td>Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.</td></tr><tr><td>IS : 5831</td><td>PVC insulation and sheath of electrical cables.</td></tr><tr><td>IS:7098 (Part -I)</td><td>Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.</td></tr><tr><td>IS : 8130</td><td>Conductors for insulated electrical cables and flexible cords.</td></tr><tr><td>IS : 10418</td><td>Specification for drums for electric cables.</td></tr><tr><td>IS : 10810</td><td>Methods of tests for cables.</td></tr><tr><td>ASTM-D -2843</td><td>Standard test method for density of smoke from the burning or decomposition of plastics.</td></tr><tr><td>IEC-754 (Part-I)</td><td>Tests on gases evolved during combustion of electric cables.</td></tr><tr><td>IEC-332</td><td>Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).</td></tr></table>				IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.	IS : 3961	Recommended current ratings for cables	IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.	IS : 5831	PVC insulation and sheath of electrical cables.	IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.	IS : 8130	Conductors for insulated electrical cables and flexible cords.	IS : 10418	Specification for drums for electric cables.	IS : 10810	Methods of tests for cables.	ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.	IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.	IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).
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IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.																									
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).																									
2.00.00	TECHNICAL REQUIREMENTS																									
2.01.00	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.																									
2.02.00	All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.																									
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E4 LT POWER CABLES	PAGE 1 OF 6																						

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
2.03.00	Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be stranded.			
2.04.00	XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.			
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.			
2.06.00	For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows :			
	Calculated nominal dia. of cable under armour		Size and Type of armour	
	Upto 13 mm		1.4mm dia GS wire	
	Above 13 & upto 25mm		0.8 mm thick GS formed wire / 1.6 mm dia GS wire	
	Above 25 & upto 40 mm		0.8mm thick GS formed wire / 2.0mm dia GS wire	
	Above 40 & upto 55mm		1.4 mm thick GS formed wire /2.5mm dia GS wire	
	Above 55 & upto 70 mm		1.4mm thick GS formed wire / 3.15mm dia GS wire	
	Above 70mm		1.4 mm thick GS formed wire / 4.0 mm dia GS wire	
2.06.01	The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm ² per meter at 20 deg C. The sizes of aluminium armouring shall be same as indicated above for galvanized steel.			
2.06.02	The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire.			
2.07.00	Outer sheath shall be of PVC as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.			
	(a.) Oxygen index of min. 29 (as per IS 10810 Part-58).			
	(b.) Acid gas emission of max. 20% (as per IEC-754-I).			
	(c.) Smoke density rating shall not be more than 60 % (as per ASTMD-2843).			
2.08.00	Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E4 LT POWER CABLES
				PAGE 2 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	1 core - Red, Black, Yellow or Blue 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red, Yellow, Blue and Black			
2.09.00	For reduced neutral conductors, the core shall be black.			
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath. (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre -To be embossed / printed The embossing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.			
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.			
2.12.00	Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum, over the declared value in the technical data sheets.			
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.			
2.14.00	Cable selection & sizing			
2.14.01	Cables shall be sized based on the following considerations: (a) Rated current of the equipment (b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage (c) Short circuit withstand capability This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.			
2.14.02	Derating Factors Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes: a) Variation in ambient temperature for cables laid in air			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E4 LT POWER CABLES
PAGE 3 OF 6				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	b) c)	Grouping of cables Variation in ground temperature and soil resistivity for buried cables.		
2.14.03	Cable lengths shall be considered in such a way that straight through cable joints are avoided.			
2.14.04	Cables shall be armoured type if laid in CHP area or directly buried.			
2.14.05	All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and sizes shall be 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm. However for cable sizes upto 120 sq.mm. both XLPE insulated & PVC insulated LT power cables are acceptable			
3.00.00	CONSTRUCTIONAL FEATURES			
3.01.00	1.1 KV Grade Power Cables			
	a) b) c)	1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/ unarmoured, PVC outer-sheathed conforming to IS:7098. (Part-I). 1.1KV grade PVC power cables shall have aluminium conductor(compact type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured/ unarmoured, PVC outer-sheathed conforming to IS:1554 (Part-I). 1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968.		
4.00.00	CABLE DRUMS			
	a) b) c.)	Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418. Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled. The standard drum length for power cables shall be 1000 meters; however for cable sizes of 1C X 630mm², 3C X 150mm² and 3C X 240mm² (sizes if applicable) standard drum length shall be 750 meters. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E4 LT POWER CABLES	PAGE 4 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS																																										
5.00.00	TESTS 1.0 All equipments to be supplied shall be of type tested design. During detailed engineering, 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 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. 2.0 However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client /Employers representative and submit the reports for approval. 3.0 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. 4.0 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.																																										
5.01.00	Type Tests																																										
5.01.01	The reports for the following type tests shall be submitted for one size each of LT XLPE and LT PVC Power cables. Size shall be decided by the employer during detailed engineering: <table><tr><th>S.No.</th><th>Type test</th><th>Remarks</th></tr><tr><td colspan="3">For Conductor</td></tr><tr><td>1.</td><td>Resistance test</td><td></td></tr><tr><td>2.</td><td>Tensile test</td><td>For circular non-compacted conductors only</td></tr><tr><td>3.</td><td>Wrapping test</td><td>For circular non-compacted only</td></tr><tr><td colspan="3">For Armour Wires/ Formed Wires</td></tr><tr><td>4.</td><td>Measurement of Dimensions</td><td></td></tr><tr><td>5.</td><td>Tensile Test</td><td></td></tr><tr><td>6.</td><td>Elongation test</td><td></td></tr><tr><td>7.</td><td>Torsion test</td><td>For round wires only</td></tr><tr><td>8.</td><td>Wrapping test</td><td>For aluminium wires / formed wires only.</td></tr><tr><td>9.</td><td>Resistance test</td><td></td></tr><tr><td>10(a)</td><td>Mass of zinc coating test</td><td>For GS Formed wires/wires only</td></tr></table>				S.No.	Type test	Remarks	For Conductor			1.	Resistance test		2.	Tensile test	For circular non-compacted conductors only	3.	Wrapping test	For circular non-compacted only	For Armour Wires/ Formed Wires			4.	Measurement of Dimensions		5.	Tensile Test		6.	Elongation test		7.	Torsion test	For round wires only	8.	Wrapping test	For aluminium wires / formed wires only.	9.	Resistance test		10(a)	Mass of zinc coating test	For GS Formed wires/wires only
S.No.	Type test	Remarks																																									
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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(1A)-2	SUB SECTION-II-E4 LT POWER CABLES	PAGE 5 OF 6																																							

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
	10(b) Uniformity of zinc coating For GS Formed wires /wires only 11. Adhesion test For GS Formed wires/wires only For PVC/XLPE insulation & PVC Sheath 12. Test for thickness 13. Tensile strength & elongation tests before ageing and after ageing 14. Ageing in air oven 15. Loss of mass test For PVC insulation and sheath only 16. Hot deformation test For PVC insulation and sheath only 17. Heat shock test For PVC insulation and sheath only 18. Shrinkage test 19. Thermal stability test For PVC insulation and sheath only 20. Hot set test For XLPE insulation only 21. Water absorption test For XLPE insulation only 22. Oxygen index test For outer sheath only 23. Smoke density test For outer sheath only 24. Acid gas generation test For outer sheath only For completed cables 25. Insulation resistance test (Volume resistivity method) 26. High voltage test 27. Flammability test as per IEC-332 Part-3 (Category-B) Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of LT power cables enclosed.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E4 LT POWER CABLES	PAGE 6 OF 6

SUB-SECTION-II-E5

LT CONTROL CABLES

**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
1.00.00	CODES & STANDARDS			
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:			
	IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.		
	IS : 3961	Recommended current ratings for cables		
	IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.		
	IS : 5831	PVC insulation and sheath of electrical cables.		
	IS : 8130	Conductors for insulated electrical cables and flexible cords.		
	IS : 10418	Specification for drums for electric cables.		
	IS : 10810	Methods of tests for cables.		
	ASTM-D –2843	Standard test method for density of smoke from the burning or decomposition of plastics.		
	IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.		
	IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).		
2.00.00	TECHNICAL REQUIREMENTS			
2.01.00	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.			
2.02.00	All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.			
2.03.00	Conductor of control cables shall be made of stranded, plain annealed copper.			
2.04.00	PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.			
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E5 LT CONTROL CABLES
PAGE 1 OF 6				

CLAUSE NO.	TECHNICAL REQUIREMENTS																	
2.06.00	For multicore armoured cables, the armouring shall be of galvanised steel as follows: <table><tr><td>Calculated nominal dia of cable under armour</td><td>Size and Type of armour</td></tr><tr><td>Upto 13 mm</td><td>1.4mm dia GS wire</td></tr><tr><td>Above 13 upto 25 mm</td><td>0.8 mm thick GS formed wire / 1.6 mm dia GS wire</td></tr><tr><td>Above 25 upto 40 mm</td><td>0.8mm thick GS formed wire / 2.0mm dia GS wire</td></tr><tr><td>Above 40 upto 55mm</td><td>1.4 mm thick GS formed wire/2.5mm dia GS wire</td></tr><tr><td>Above 55 upto 70 mm</td><td>1.4mm thick GS formed wire / 3.15mm dia GS wire</td></tr><tr><td>Above 70mm</td><td>1.4 mm thick GS formed wire / 4.0 mm dia GS wire</td></tr></table> The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.				Calculated nominal dia of cable under armour	Size and Type of armour	Upto 13 mm	1.4mm dia GS wire	Above 13 upto 25 mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire	Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire	Above 40 upto 55mm	1.4 mm thick GS formed wire/2.5mm dia GS wire	Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire
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Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire																	
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire																	
2.07.00	Outer sheath shall be of PVC as per IS: 5831 and grey in colour. In addition to meeting all the requirements of Indian Standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a.) Oxygen index of min. 29. (As per IS 10810 Part-58) (b.) Acid gas emission of max. 20% (As per IEC-754-I) (c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM D-2843.																	
2.08.00	Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted. <table><tr><td>1 core -</td><td>Red, Black, Yellow or Blue</td></tr><tr><td>2 core -</td><td>Red & Black</td></tr><tr><td>3 core -</td><td>Red, Yellow & Blue</td></tr><tr><td>4 core -</td><td>Red, Yellow, Blue and Black</td></tr><tr><td>5 core -</td><td>Red, Yellow, Blue, Black and Grey</td></tr></table>				1 core -	Red, Black, Yellow or Blue	2 core -	Red & Black	3 core -	Red, Yellow & Blue	4 core -	Red, Yellow, Blue and Black	5 core -	Red, Yellow, Blue, Black and Grey				
1 core -	Red, Black, Yellow or Blue																	
2 core -	Red & Black																	
3 core -	Red, Yellow & Blue																	
4 core -	Red, Yellow, Blue and Black																	
5 core -	Red, Yellow, Blue, Black and Grey																	
2.09.00	For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed																	
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E5 LT CONTROL CABLES														
PAGE 2 OF 6																		

CLAUSE NO.	TECHNICAL REQUIREMENTS													
2.10.00	underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm. In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath: (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed. The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.													
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.													
2.12.00	Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum over the declared value in the technical data sheets.													
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.													
2.14.00	Cable selection & sizing Control cables shall be sized based on the following considerations: (a) The minimum conductor cross-section shall be 1.5 sq.mm. (b) The minimum number of spare cores in control cables shall be as follows: <table><tr><td>No. of cores in cable</td><td>Min. No. of spare cores</td></tr><tr><td>2C, 3C</td><td>NIL</td></tr><tr><td>5C</td><td>1</td></tr><tr><td>7C-12C</td><td>2</td></tr><tr><td>14C & above</td><td>3</td></tr></table>				No. of cores in cable	Min. No. of spare cores	2C, 3C	NIL	5C	1	7C-12C	2	14C & above	3
No. of cores in cable	Min. No. of spare cores													
2C, 3C	NIL													
5C	1													
7C-12C	2													
14C & above	3													
2.14.01	Cable lengths shall be considered in such a way that straight through cable joints are avoided.													
2.14.02	Cables shall be armoured type if laid in CHP area or directly buried.													
3.00.00	CONSTRUCTIONAL FEATURES													
3.01.00	1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).													
3.02.00	1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-													
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E5 LT CONTROL CABLES										
PAGE 3 OF 6														

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	S. No.	Type Test	Remarks	
		For Conductor		
	1.	Resistance test		
		For Armour Wires / Formed Wires (If applicable)		
	2.	Measurement of Dimensions		
	3.	Tensile Test		
	4.	Elongation test		
	5.	Torsion test	For round wire only	
	6.	Wrapping test	For aluminium wires / formed wires only.	
	7.	Resistance test		
	8(a).	Mass of zinc Coating test	For GS wires/formed wires only	
	8(b).	Uniformity of zinc coating	For GS wires/formed wires only	
	9.	Adhesion test	For GS wires/formed wires only	
		For PVC insulation & PVC Sheath		
	10.	Test for thickness		
	11.	Tensile strength and elongation test	before ageing and after ageing	
	12.	Ageing in air oven		
	13.	Loss of mass test	For PVC insulation and sheath only	
	14.	Hot deformation test	For PVC insulation and sheath only	
	15.	Heat shock test	For PVC insulation and sheath only	
	16.	Shrinkage test		
	17.	Thermal stability test	For PVC insulation and sheath only	
	18.	Oxygen index test	For outer sheath only	
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E5 LT CONTROL CABLES
PAGE 5 OF 6				

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
5.02.00	S. No.	Type Test	Remarks
	19.	Smoke density test	For outer sheath only
	20.	Acid gas generation test	For outer sheath only
	For completed cables		
	21.	Insulation resistance test(Volume resistivity method)	
	22.	High voltage test	
	23.	Flammability test as per IEC-332 Part-3 (Category-B)	
	Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Control Cables enclosed.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E5 LT CONTROL CABLES PAGE 6 OF 6

SUB-SECTION-II-E6

CABLING EARTHING & LIGHTNING PROTECTION

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																																													
1.00.00	CODES AND STANDARDS																																													
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable . <table><tr><td>IS:513</td><td>Cold rolled low carbon steel sheets and strips.</td></tr><tr><td>IS:802</td><td>Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.</td></tr><tr><td>IS:1079</td><td>Hot Rolled carbon steel sheet & strips</td></tr><tr><td>IS:1239</td><td>Mild steel tubes, tubulars and other wrought steel fittings</td></tr><tr><td>IS:1255</td><td>Code of practice for installation and maintenance of power cables upto and including 33 KV rating</td></tr><tr><td>IS:1367 Part-13</td><td>Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).</td></tr><tr><td>IS:2147</td><td>Degree of protection provided by enclosures for low voltage switchgear and control gear</td></tr><tr><td>IS:2309</td><td>Code of Practice for the protection of building and allied structures against lightning.</td></tr><tr><td>IS:2629</td><td>Recommended practice for hot dip galvanising of iron & steel</td></tr><tr><td>IS:2633</td><td>Method for testing uniformity of coating on zinc coated articles.</td></tr><tr><td>IS:3043</td><td>Code of practice for Earthing</td></tr><tr><td>IS:3063</td><td>Fasteners single coil rectangular section spring washers.</td></tr><tr><td>IS:6745</td><td>Methods for determination of mass of zinc coating on zinc coated iron & steel articles.</td></tr><tr><td>IS:8308</td><td>Compression type tubular in- line connectors for aluminium conductors of insulated cables</td></tr><tr><td>IS:8309</td><td>Compression type tubular terminal ends for aluminium conductors of insulated cables.</td></tr><tr><td>IS:9537</td><td>Conduits for electrical installation.</td></tr><tr><td>IS:9595</td><td>Metal - arc welding of carbon and carbon manganese steels - recommendations.</td></tr><tr><td>IS:13573</td><td>Joints and terminations for polymeric cables.</td></tr><tr><td>BS:476</td><td>Fire tests on building materials and structures</td></tr><tr><td>IEEE:80</td><td>IEEE guide for safety in AC substation grounding</td></tr><tr><td>IEEE:142</td><td>Grounding of Industrial & commercial power systems</td></tr></table>				IS:513	Cold rolled low carbon steel sheets and strips.	IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.	IS:1079	Hot Rolled carbon steel sheet & strips	IS:1239	Mild steel tubes, tubulars and other wrought steel fittings	IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating	IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).	IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear	IS:2309	Code of Practice for the protection of building and allied structures against lightning.	IS:2629	Recommended practice for hot dip galvanising of iron & steel	IS:2633	Method for testing uniformity of coating on zinc coated articles.	IS:3043	Code of practice for Earthing	IS:3063	Fasteners single coil rectangular section spring washers.	IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.	IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables	IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.	IS:9537	Conduits for electrical installation.	IS:9595	Metal - arc welding of carbon and carbon manganese steels - recommendations.	IS:13573	Joints and terminations for polymeric cables.	BS:476	Fire tests on building materials and structures	IEEE:80	IEEE guide for safety in AC substation grounding	IEEE:142	Grounding of Industrial & commercial power systems
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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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 1 of 69																																										

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.		
	DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors		
	BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.		
		Indian Electricity Act.		
		Indian Electricity Rules.		
1.02.00	Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.			
2.00.00	DESIGN AND CONSTRUCTIONAL FEATURE			
2.01.00	Inter Plant Cabling			
2.01.01	Interplant cabling for main routes shall be laid along overhead trestles/duct banks. Cables from main plant to switchyard control room shall be laid in overhead trestles or duct bank. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. Directly buried cables, if essential, shall not have concentration of more than 4 cables in one route. All buried cables shall be armoured			
2.01.02	Transformer yard			
	In transformer yard cables shall be laid in overhead trestle. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles. In transformer yard, trestle height for rail/road crossing shall be suitable for movement of Generator Transformer with bushing.			
2.01.03	Trenches			
	PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.			
2.01.04	No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant.			
2.01.05	Cable Vault			
	The cable vault/ / cable spreader room space below the HT / LT switchgear room, Control Rooms, unit control equipment room, Programmer room, UPS, Charger & Battery Rooms, shall have 800 mm wide and 2.1 m high movement passage all around the cable trays in the cable vault/ cable spreader room for easy laying/maintenance of cables			
	Cable vaults shall be provided with adequate drainage facilities for drainage of fire water.			
	Each cable vault should have at least two doors.			
	Exit signs shall be provided near doors for personnel escape in case of emergency			
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 2 of 69

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
2.01.06	Boiler Area Cable trays in boiler & ESP area shall be supported from the boiler and ESP structures. The same shall be coordinated with SG/ESP contractor. Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in boiler/ESP area.			
2.01.07	Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries.			
2.01.08	OffSite Area For feeder in bidder's scope for offsite areas, overhead cable tray arrangement shall be followed. However cable trenches/slit may also be acceptable, for some areas, if found to be required during detailed engineering. Cable trenches provided shall be separated from fuel oil area to avoid oil accumulation.			
2.01.09	The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.			
2.01.10	Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable.			
2.01.11	Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to:			
	Meet all safety requirements Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc			
3.00.00	EQUIPMENT DESCRIPTION			
3.01.00	Cable trays, Fittings & Accessories			
3.01.01	Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.			
3.01.02	Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter.			
3.01.03	Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.			
3.01.04	Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.			
3.01.05	The tolerance for cable tray and accessories shall be as per IS 2102 (Part-1). Tolerance Class: - Coarse			
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 3 of 69

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.02.00 3.02.01 3.02.02 3.02.03	Support System for Cable Trays Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings. 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 a. 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. b. 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. c. 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 d. All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation. e. 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. f. 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. g. 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. 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-IA 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		
	the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid.		
3.02.04	Four legged structure shall be provided wherever there is change in elevation and change in direction		
3.02.05	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.		
3.03.00	Pipes, Fittings & Accessories		
3.03.01	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		
3.03.02	GI Pipes shall be of medium duty as per IS: 1239		
3.03.03	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.		
3.03.04	Hume pipes shall be NP3 type as per IS 458.		
3.03.05	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		
3.03.06	HDPE pipes and conduits shall be PE-80, PN-10 type as per IS 4984/IS 8008 part-I.		
3.04.00	Junction Boxes		
3.04.01	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-IA 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-IA 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			
	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-IA 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													
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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-IA 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										

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	b) While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.		
4.04.03	Cables shall be laid on cable trays strictly in line with cable schedule		
4.04.04	Power and control cables shall be laid on separate tiers inline with the approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on top most tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with cable clamps/ties with self locking arrangement. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by cable clamps/ties with self locking arrangement at every five meter interval and at every bend. Fibre Optical cable shall be laid in trenches/trays or as decided by Employer.		
4.04.05	Bending radii for cables shall be as per manufacturer's recommendations and IS:1255.		
4.04.06	Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe.		
4.04.07	No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length.		
4.04.08	In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.		
4.04.09	Wherever few cables are branching out from main trunk route troughs shall be used.		
4.04.10	Wind loading shall be considered for designing support as well Cable trays wherever required.		
4.04.11	Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures.		
4.04.12	The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.		
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION
			Page 10 of 69

CLAUSE NO.	TECHNICAL REQUIREMENTS													
4.04.13	Separation At least 300mm clearance shall be provided between: - HT power & LT power cables, - LT power & LT control/instrumentation cables,													
4.04.14	Segregation 1) Segregation means physical isolation to prevent fire jumping. 2) All cables associated with the unit shall be segregated from cables of other units. 3) 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. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set. 4) In switchyard, control cables of each bay shall be laid on separate racks/trays.													
4.04.15	Minimum number of spare cores required to be left for interconnection in control cables shall be as follows: Minimum number of spare cores required to be left for interconnection in control cables shall be as follows: <table><tr><td>No. of cores in cable</td><td>No. of spare cores</td></tr><tr><td>2C,3C</td><td>NIL</td></tr><tr><td>5C</td><td>1</td></tr><tr><td>7C-10C</td><td>2</td></tr><tr><td>14C and above</td><td>3</td></tr></table>				No. of cores in cable	No. of spare cores	2C,3C	NIL	5C	1	7C-10C	2	14C and above	3
No. of cores in cable	No. of spare cores													
2C,3C	NIL													
5C	1													
7C-10C	2													
14C and above	3													
4.04.16	Directly Buried Cables a) Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS:1255 and the enclosed drawings showing cabling details. b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.													
4.04.17	Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at													
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 11 of 69										

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags. The cable tag requirements mentioned above shall prevail over Tag requirements mentioned elsewhere in this document for HT power, LT power & control cables.			
4.04.18	While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.			
4.05.00	Cable Terminations & Connections			
4.05.01	The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.			
4.05.02	Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.			
4.05.03	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.			
4.05.04	Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.			
4.05.05	All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing.			
4.05.06	All cable terminations shall be appropriately tightened to ensure secure and reliable connections.			
5.00.00	EARTHING SYSTEM			
5.01.00	Earthing system shall be in strict accordance with IS:3043 and Indian Electricity Rules/Acts The earthing system shall be designed for a life expectancy of at least forty (40) years, for a system fault current of 50 kA for 1.0 sec. The minimum rate of corrosion of steel for selection of earthing conductor shall be 0.12mm per year.			
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 12 of 69	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.05.00	h) Crane, rails, rail tracks & other non-current carrying metal parts	25 x 6mm GS flat	
5.06.00	Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise approved. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable.		
5.07.00	Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground		
5.08.00	Neutral points of HT transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to earth electrodes by suitable earth conductors.		
5.09.00	Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.		
5.10.00	Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.		
5.11.00	Suitable earth risers as approved shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.		
5.12.00	Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding.		
5.13.00	Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.		
5.14.00	Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.		
5.15.00	Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.		
	A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.		
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION
Page 14 of 69			

CLAUSE NO.	TECHNICAL REQUIREMENTS																						
5.16.00	Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.																						
5.17.00	Earth pit shall be of treated type & shall be constructed as per IS:3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal as per IS:3043. Test links shall be provided with bolted arrangement alongwith each earth pit, in order to facilitate measurement of earth resistance as & when required.																						
5.18.00	On completion of installation continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. All equipment required for testing shall be furnished by contractor.																						
5.19.00	Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.																						
5.20.00	Other Requirements of Earthing System: <table><tr><td>Standard/Code</td><td>IEEE 80, IS 3043</td></tr><tr><td>Earthing System</td><td></td></tr><tr><td>Life expectancy</td><td>40 Years</td></tr><tr><td>System Fault Level</td><td>System Fault Level 50 KA for 1 sec</td></tr><tr><td>Soil resistivity</td><td>Actual as per site conditions.</td></tr><tr><td>Min. Steel corrosion</td><td>0.12mm/year</td></tr><tr><td>Depth of burial of main earth conductor</td><td>600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.</td></tr><tr><td>Conductor joints</td><td>By electric arc welding, with resistance of joint not more than that of the conductor.</td></tr><tr><td colspan="2">Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.</td></tr><tr><td>Surface resistivity</td><td>- Gravel 3000 ohm-meter - Concrete 500 ohm-meter</td></tr></table>			Standard/Code	IEEE 80, IS 3043	Earthing System		Life expectancy	40 Years	System Fault Level	System Fault Level 50 KA for 1 sec	Soil resistivity	Actual as per site conditions.	Min. Steel corrosion	0.12mm/year	Depth of burial of main earth conductor	600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.	Conductor joints	By electric arc welding, with resistance of joint not more than that of the conductor.	Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.		Surface resistivity	- Gravel 3000 ohm-meter - Concrete 500 ohm-meter
Standard/Code	IEEE 80, IS 3043																						
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Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.																							
Surface resistivity	- Gravel 3000 ohm-meter - Concrete 500 ohm-meter																						
6.00.00	LIGHTNING PROTECTION SYSTEM																						
6.01.01	Lightning protection system shall be in strict accordance with IEC : 62305 and latest IS standards.																						
6.01.02	Lightning conductor shall be of 25x6mm GS strip when used above ground level and shall be connected through test link with earth electrode/earthing system																						
6.01.03	Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings.																						
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION																				
Page 15 of 69																							

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
6.02.00	Down Conductors - Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode. - Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. - All joints in the down conductors shall be welded type. - Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval. - Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm. - All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system. - Lightning conductors shall not pass through or run inside GI Conduits. - Testing link shall be made of galvanized steel of size 25x 6mm. - Pulser system for lightning shall not be accepted. - Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths.		
7.00.00	TESTS		
7.01.01	All equipment to be supplied shall be of type tested design. During detail engineering, 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 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.		
7.01.02	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.		
7.01.03	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.		
7.01.04	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.		
7.02.00	Type Test reports shall be furnished for the following		
7.02.01	Type tests on Cable Trays support system		
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION Page 16 of 69

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	a) Test 1A: On main support channel type-C2 for cantilever arms fixed on one side only. A 3.5 meter length of main support channel shall be fixed vertically at each end to a rigid structure as per the fixing arrangement as shown in the enclosed drawing. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the points shown in the enclosed drawings and at the following load intervals: i) Working load ii) Working load + point load iii) Off load iv) Proof load + point load v) Off load The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied. B) Test 1B: Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2 Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides a) Test 2A: A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per the fixing arrangement as shown in the enclosed drawing. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals. i) Working load ii) Working load + Point load iii) Off load iv) Proof load + Point load v) Off load The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied		
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 17 of 69

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	b) Test 2 B: The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side. Test 3 : Tests on Channel Fixed on Beam/Floor A length of main support channel section shall be fixed to steel structure/floor and have loads applied as shown in the drawing enclosed and as detailed below a) Test 3A : A length of steel structure shall be rigidly supported. It should be fitted on a meter length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place. b) Test 3B: With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place. c) Test 3C: With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line. The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded. Test 4 : Channel Insert Test A 2.5 m length of C1 channel fixed to the concrete wall/ steel structure as per actual site installation conditions. 6 nos. of 750 mm cantilever arms shall be attached to C1 channel as shown in enclosed drawing. Each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals. i) Working Load ii) Working Load + Point Load iii) Off Load iv) Proof Load + Point Load v) Off load The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied Test 5 : Channel nut slip characteristics (what ever applicable) Tests 5A1,5A2,5A3 : A length of channel C1 section 200mm long shall have fitted bracket with the two bolt fixing as shown in drawing enclosed.			
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 18 of 69

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	With loads applied at the position shown in drawing enclosed nut slip shall be determined with bolt torque of 30NM, 50 NM and 65 NM No fewer than three measurements shall be made for each torque setting. A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM. Tests 5B1,5B2,5B3: The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting. A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM. Test 6 Weld Integrity Test After deflection test as per test 1A, 1B, 2, 3 & 4 weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any.			
7.02.02	Cable termination kit and straight through joints should have been tested as per IS:13573 for 3.3kV grade & above.			
7.03.00	Routine/ Acceptance Tests			
7.03.01	Routine Tests			
	a) Routine tests as per specification and applicable standards shall be carried out on all requirements/items covered in the specification. b) Physical & dimensional check on all equipments as per approved drawings/standards c) HV/IR as applicable. d) Check/measurement of thickness of paint/zinc coating/nickel-chrome plating as per specification & applicable standard.			
7.03.02	Acceptance Test			
	a) Galvanising Tests as per applicable standards b) Welding checks c) Deflection tests on cable trays: d) One piece each of 2.5m length of cable tray of 300mm & above shall be taken as sample from each offered lot. It shall be supported at both end & loaded with uniform load of 76 kg/meter along the length of cable tray. The maximum deflection at the mid-span of each size shall not exceed 7mm. d) Proof load tests on cable tray support system			
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 19 of 69

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	i) Tests on Main Support Channel shall be done if only C1 Channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test. ii) Test on Main Support Channel shall be done with C2 channel and cantilever arms fitted on both sides, if C2 channels are in scope of supply. This test shall be same as test 2A of type test. Then test (i) above shall not be done. iii) Nut slip characteristic test (it shall support minimum load of 350kg before nut slips with a bolt torque of 65 NM). This test shall be same as test 5B3 of type test. The procedure for carrying out tests at “d” above shall be as per details given in Type Tests in specification thereafter Die-Penetration test shall be carried out to check weld integrity. e) The above acceptance tests shall be done only on one sample from each offered lot.			
8.00.00	COMMISSIONING			
8.01.01	The Contractor shall carry out the following commissioning tests and checks after installation at site. In addition the Contractor shall carry out all other checks and tests as recommended by the Manufacturers or else required for satisfactory performance..			
8.01.02	Cables a) Check for physical damage b) Check for insulation resistance before and after termination/jointing. c) HT cables shall be pressure tested (test voltage as per IS:7098) before commissioning. d) Check of continuity of all cores of the cables. e) Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections, etc., shall be carried out by the Contractor. f) Check for correct polarity and phasing of cable connections. g) Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc. h) Check for provision of correct cable tags, core ferrules, tightness of connections.			
8.02.00	Cable trays / supports and accessories 1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories. 2) Check for continuity of cable trays over the entire route. 3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.			
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 20 of 69

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.03.00	4)	Check for earth continuity and earth connection of cable trays.		
	Earthing and Lightning protection system			
9.00.00	1)	Earth continuity checks.		
	2)	Earth resistance of the complete system as well as sub-system.		
	ELECTRICAL LAYOUT PHILOSOPHY:			
	While developing the layout the bidder must give due consideration to the following requirements:			
	a) Adequate distance shall be maintained between the transformers. As basic guidelines following norms will be adhered to:			
	1)	Transformers shall be separated from the adjacent building/structures and from each other by a minimum distance as defined below or by a fire wall of two hours of fire resisting of height at least 600 mm above bushing / pressure relief vent whichever is higher.		
		Oil capacity of individual transformer (in liters)	Clear separating distance (in meters)	
		5,000 to 10,000	8.0	
		10,001 to 20,000	10.0	
		20,001 to 30,000	12.5	
	Over 30,001	15.0		
2)	In case of auxiliary transformers having an aggregate oil capacity in excess of 2300 liters but individual oil capacity of less than 5000 liters, the maximum separating distance between transformers and surrounding building shall be at least 6M unless they are separated by fire separating walls or are protected by high velocity spray system.			
3.)	Rail track shall be provided in Transformer yard for movement of each transformer. The rail track in Transformer yard shall be connected with TG area rail track The Foundation top of transformer & rail top shall be at EL +/- 0.0M. Bus duct support or Transformer body shall be at least 8.0M from A-Row of TG building to clear the movement of GT/ Stator/UT/ST/UAT on rail line. Jacking pads shall be provided where the rail track changes the direction. Mooring post shall be provided on rail track for handling the transformers.			
4)	For each transformer a pit shall be provided all around at a distance of 1.5 m (minimum) from transformer outer edge. A sump pit shall be provided for each pit. A common oil retention pit per unit shall be provided to hold oil quantity of the largest transformer (by volume) & 10 minutes of water quantity of HVW spray system for the largest transformer. Sump pit of individual transformer shall be connected to common oil retention pit of that unit.			
5)	Rail track shall be provided for all outdoor transformers up to road for movement of each transformer of size more than or equal to 7.5MVA Transformer. Jacking pads shall be provided where the rail track changes the direction. Jacking pad			
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 21 of 69

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	shall also be provided at the location of installation of transformer and mooring post shall be provided on rail track for handling the transformers. 6.) The Transformer fencing shall be at 1.0 M (minimum) distance from the pit wall. The Height of fencing shall be 2.5 M (minimum) and fencing shall have personal entry gate and removable type fencing/gate for transformer withdrawal. 7) The transformer firewall, pit sizing and clearances from adjacent building/structures etc. shall be as per IS 1646/CBIP manual on Transformer 8) However, for all outdoor transformers of oil capacity less than 2000 litre, a trench of suitable size shall be provided all around at a distance of 1.0 m (minimum) from transformer outer edge. A sump pit shall be provided for each trench. b) Layout requirements for Electrical MCC/switchgear rooms 1. Separate Switchgear Rooms shall be provided for each unit. For TG building, all HT boards shall be provided in HT switchgear room at only one floor and all LT boards shall be provided in LT switchgear room at only one floor 2. The following clearances shall be maintained for HT Switchboard. a.) Front Clearance i) For one Row of Swgr. - 2.0 M (Min) ii) For two Rows of Swgr. - 2.5 M (Min) b.) Back Clearance - 1.5 M (Min.) c.) Side Clearance Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 800+width of panel (including spare panels/dummy panels etc.) 3. The following clearances shall be maintained for LT Switchboard. a.) Front Clearance i) For one Row of Swgr - 1.5M (Min) ii) For two Rows of Swgr - 1.5/1.75M depending upon the depth of panels etc b.) Back Clearance i) For single front - 1.0M (Min) ii) For double front - 1.5M (Min) c.) Side Clearance Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 800 mm + width of panel. For offsite areas, HT Switchboard clearances shall be followed wherever both LT & HT switch boards are in the same MCC room.			
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 22 of 69	

CLAUSE NO.	TECHNICAL REQUIREMENTS 										
	4. Height of HT/LT Switchgear Room and Boiler MCC room <table border="0"> <tr> <td>i)</td><td>With Bus Duct</td><td>–</td><td>4.5 m (min)</td></tr> <tr> <td>ii)</td><td>Without Bus Duct</td><td>–</td><td>4.0 m (min)</td></tr> </table> Further no vertical bracings shall be envisaged in HT/LT switchgear room and associated cable vault area. 5. Cable trench/Cable vault For LT switchgear/MCC room at EL 0.0M, minimum 1400 wide x 1400 deep cable trench shall be provided to route the cables. Horizontal cable trays shall be routed in cable trenches. c) Minimum clear working space around the equipment 1200mm d) In buildings having MCC, minimum 2 fire door along with one rolling shutter of adequate size/capacity shall be provided			i)	With Bus Duct	–	4.5 m (min)	ii)	Without Bus Duct	–	4.0 m (min)
i)	With Bus Duct	–	4.5 m (min)								
ii)	Without Bus Duct	–	4.0 m (min)								
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-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	Page 23 of 69								

SECTION A-A

SECTION B-B

SECTION C-C

SLOTTED RUNG

COUPLER PLATE

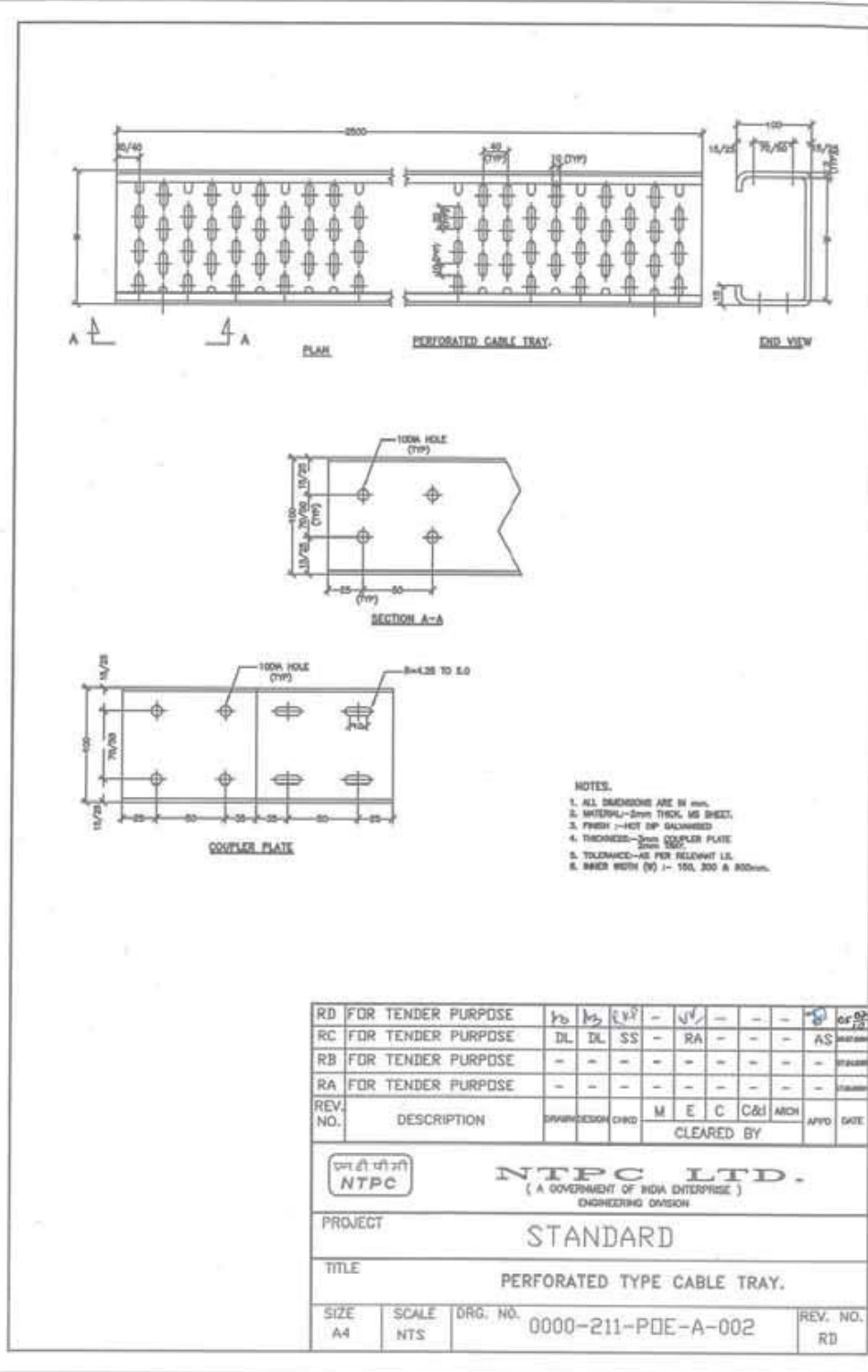
SIDE RUNNER

FIXING CLAMP

NOTES.

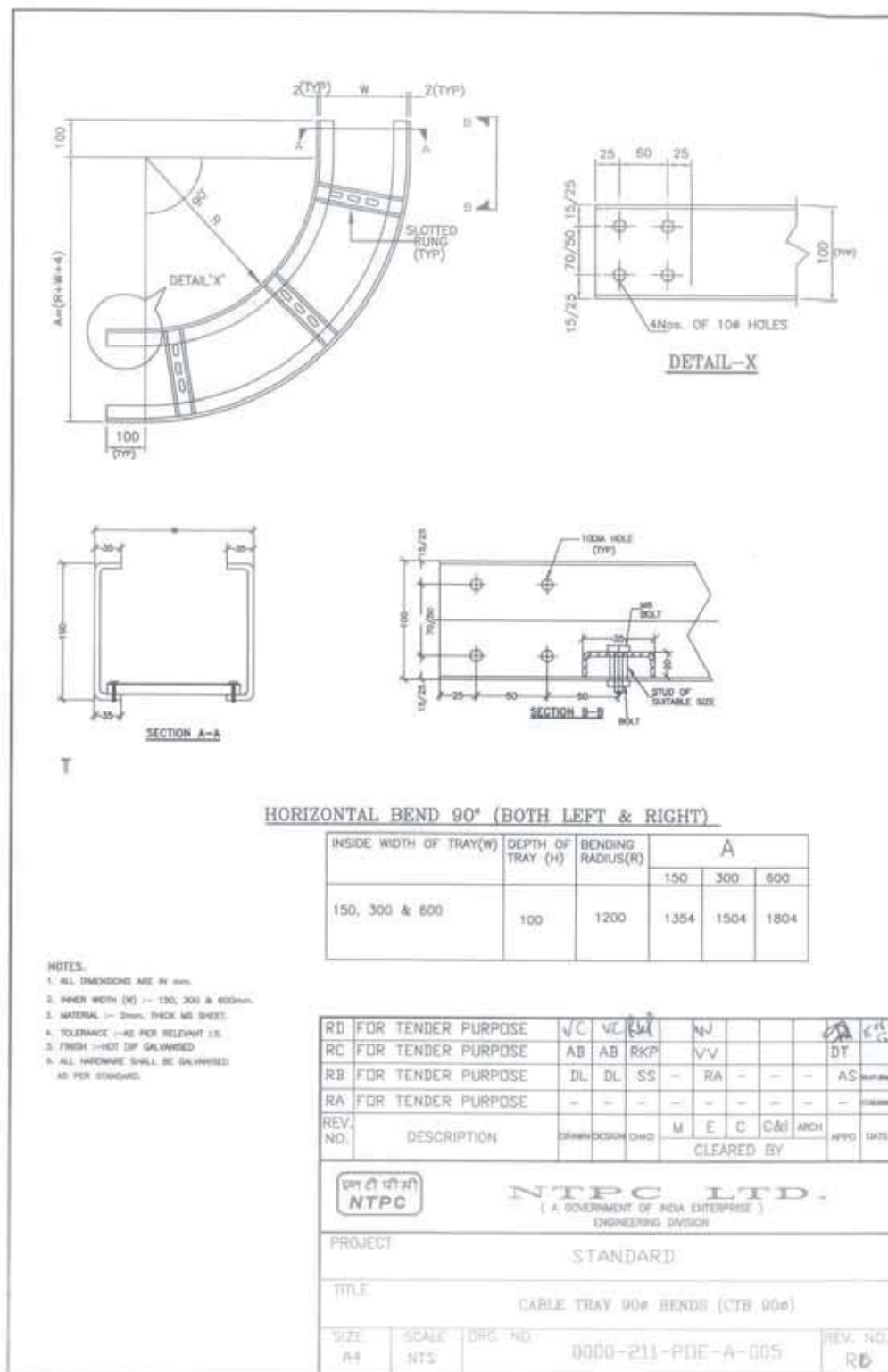
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL:-2mm THICK MS SHEET.
3. FINISH :-HOT DIP GALVANIZED.
4. THICKNESS:-2mm COUPLER PLATE
5. TOLERANCE:-AS PER RELEVANT IS.

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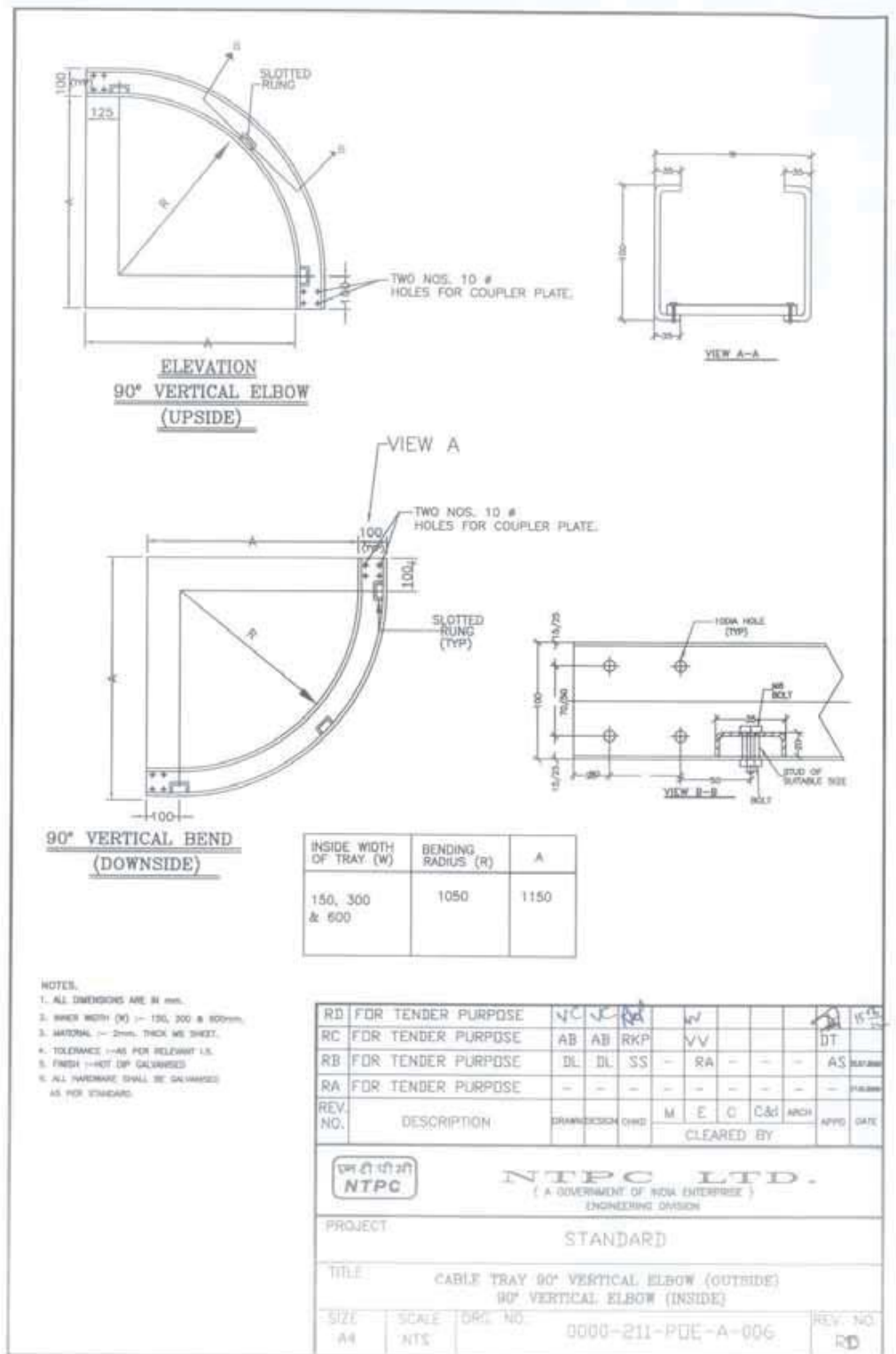


[illegible]

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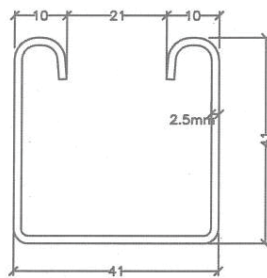
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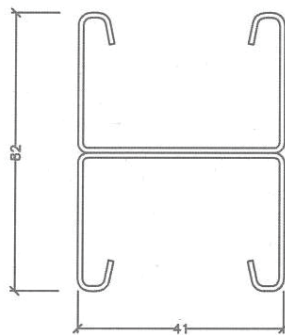
PLAN

INSIDE WIDTH OF TRAY (W)	BENDING RADIUS (R)	A = $\frac{R+W}{2} + 100$
600	1050	1450
300	1050	1300

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SINGLE CHANNEL-TYPE C1



DOUBLE CHANNEL-TYPE C2

TWO LENGTHS OF C1 WELDED BACK TO BACK

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :- 3.5mm THICK MS SHEET.
3. TOLERANCE :- AS PER RELEVANT IS.
4. FINISH :- HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	A2	A3	CM	-	W	-	-	-	AS	17/03/2017
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	17/03/2017
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	AS	17/03/2017
REV. NO.	DESCRIPTION	DATE	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
Cleared By											
 NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE C1 & C2 CHANNEL, CABLE TRAY SUPPORT SYSTEM											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-013								REV. NO. RC	

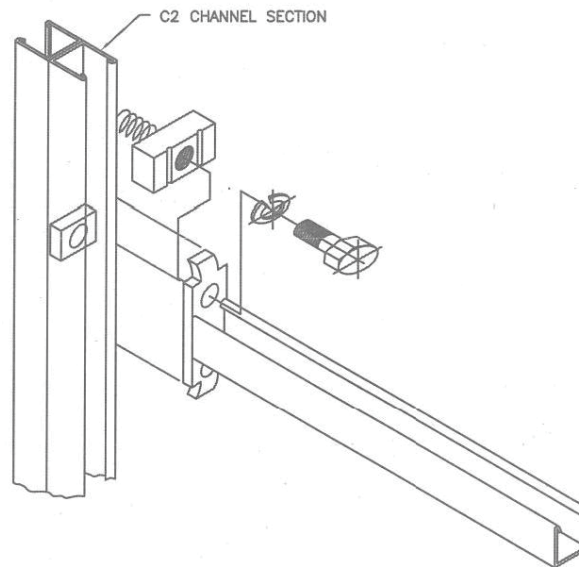
TYPICAL DETAILS OF FIXING ACCESSORIES

NOTES:
 1. MATERIAL :- MILD STEEL
 2. FINISH :- HOT DIP GALVANIZED

RC FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	AS 92
RB FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	STANDARD
RA FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	STANDARD
REV. NO.	DESCRIPTION	DESIGNED	CHECKED	M	E	C	C&I	INCH	APPRO	DATE
Cleared By										
एन टी सी लिमिटेड NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION										
PROJECT : STANDARD										
TITLE : TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM										
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-014							REV. NO. RC	

TRAYIA-211-014

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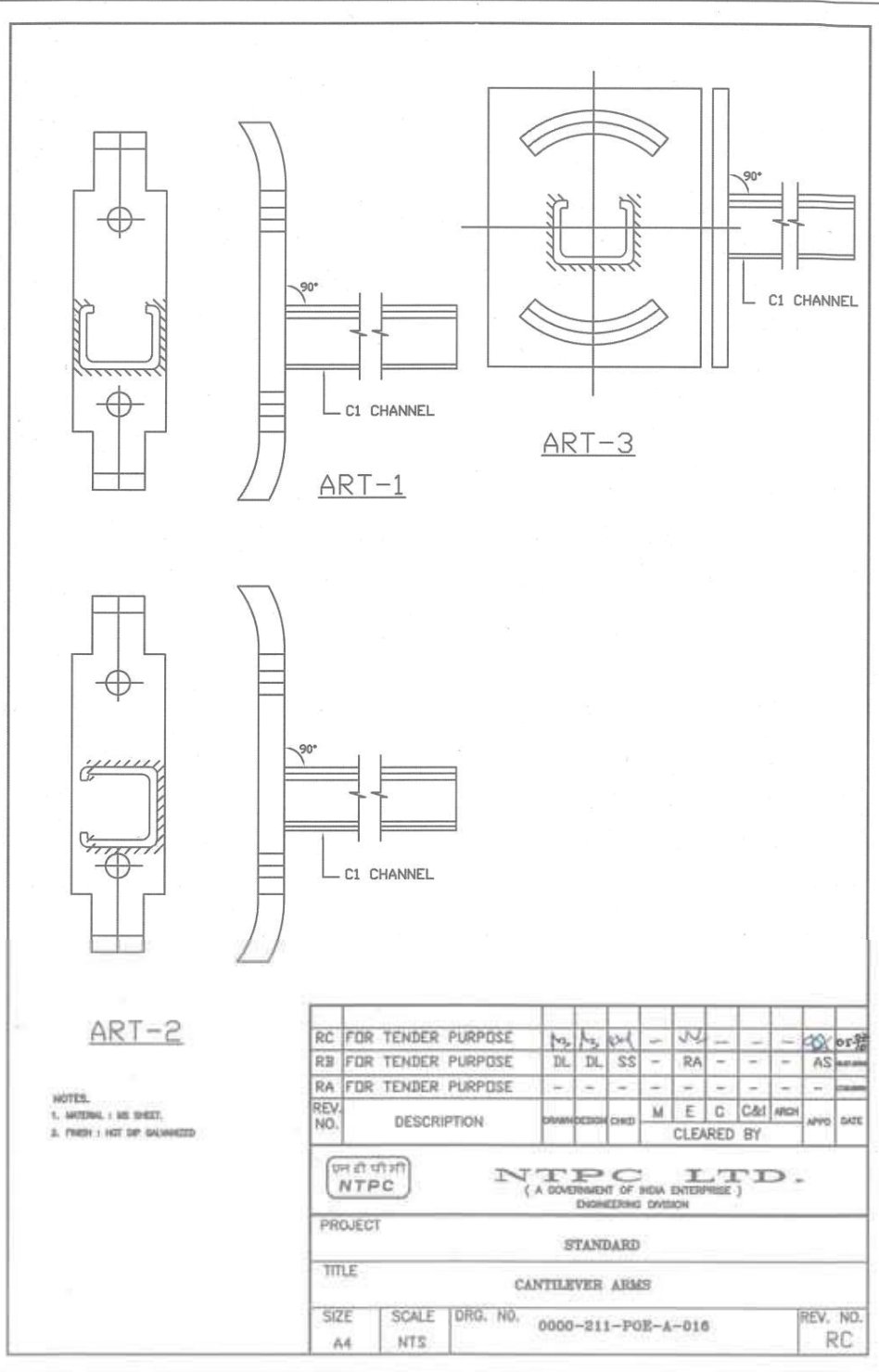


NOTE.

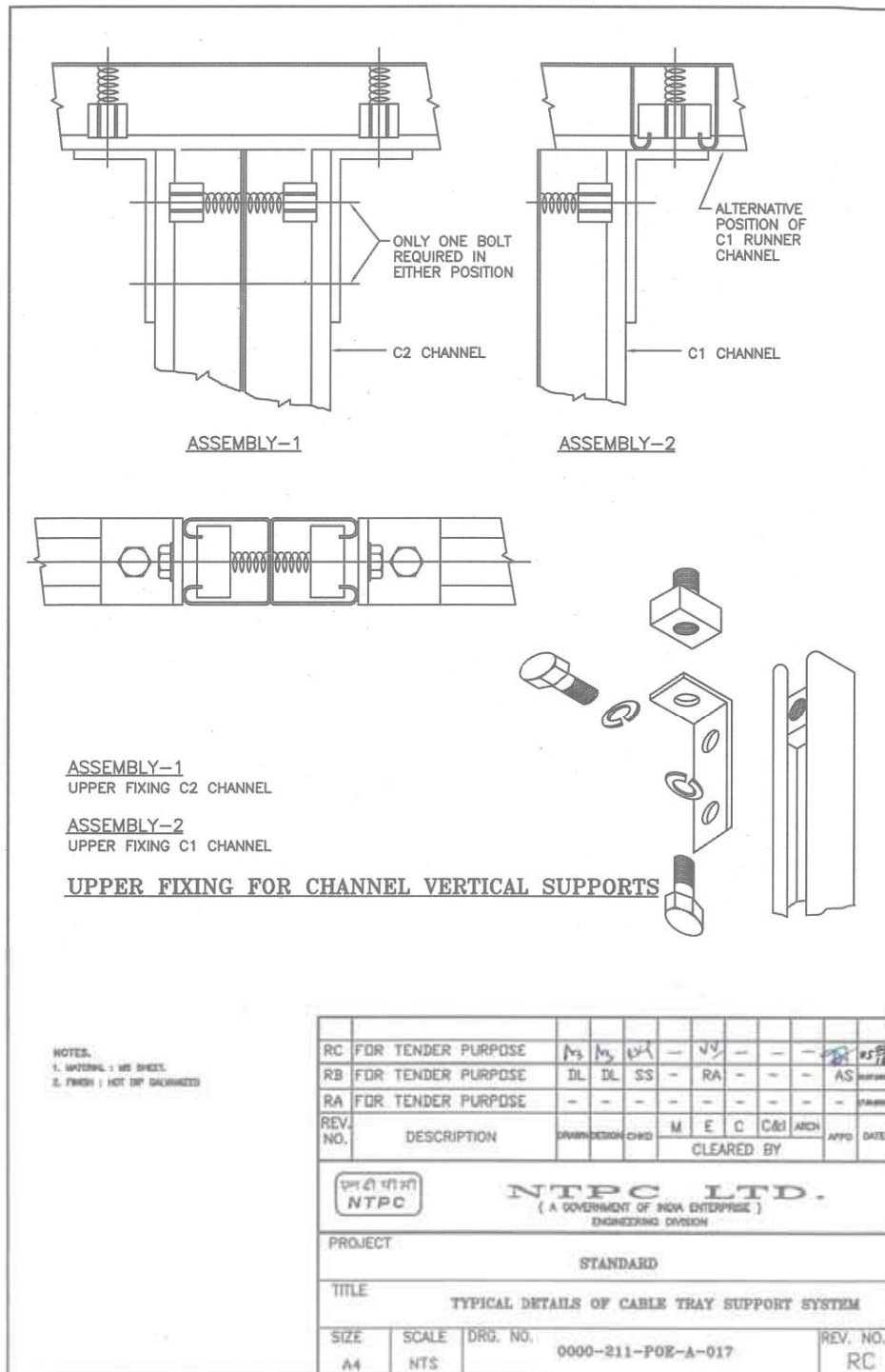
1. FIRST - NOT OF SIGNIFICANCE

RC	FOR TENDER PURPOSE	1/2	1/2	1/2	-	✓	-	-	-	✓	✓
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	✓
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	✓
REV. NO.	DESCRIPTION	DESIGNED	CHECKED	DATE	M	E	C	C&I	ARCH	APPD	DATE
 NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT: STANDARD											
TITLE: TYPICAL DETAIL OF CABLE TRAY SUPPORT SYSTEM											
SIZE	SCALE	DRG. NO.		0000-211-POR-A-015						REV. NO.	
A4	NTS									RC	

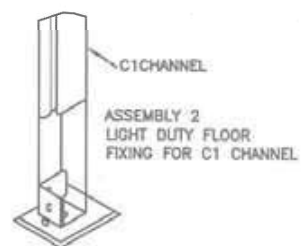
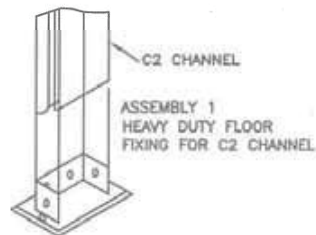
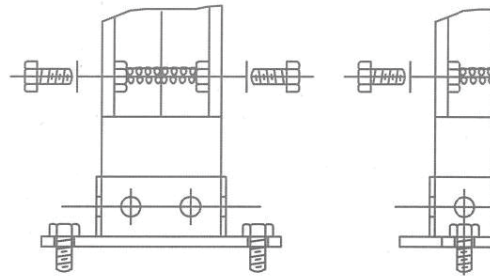
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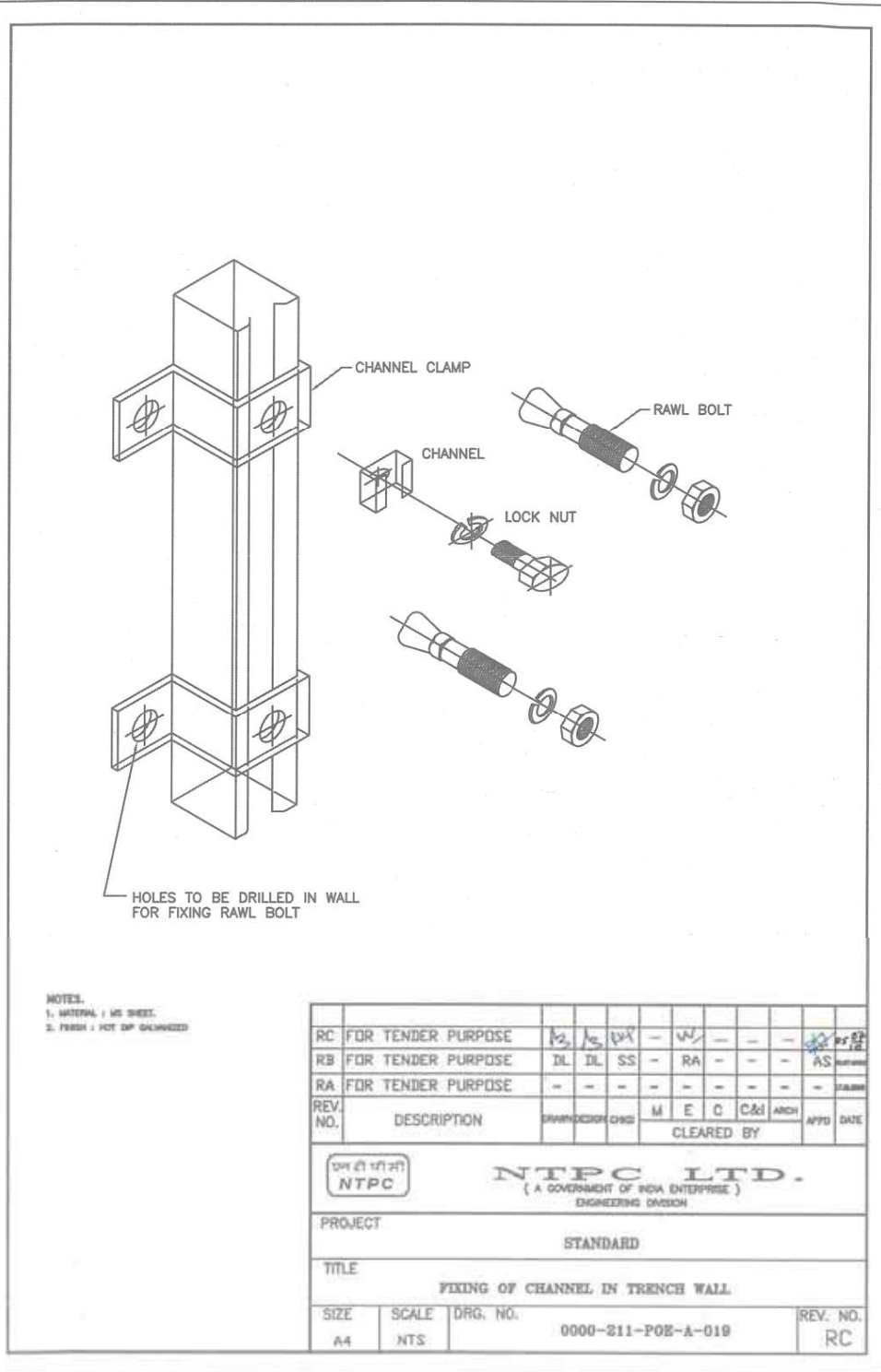


FLOOR FIXING FOR CHANNEL VERTICAL SUPPORTS

NOTES:
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

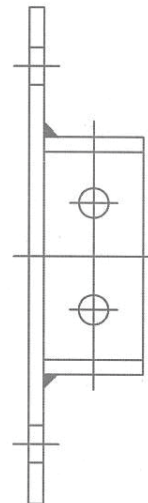
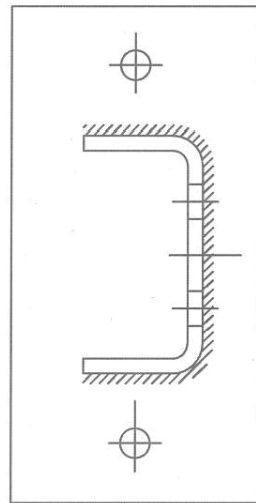
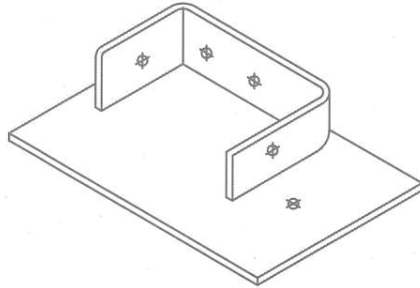
RC	FOR TENDER PURPOSE	M ₂	M ₃	GVK	-	V ₂	-	-	-	AS	REVISION
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	REVISION
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	REVISION
REV. NO.	DESCRIPTION	DESIGN	DESIGN CHG	M	E	C	C&I	ARCH	APPR	DATE	
एनटीपीसी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT: STANDARD											
TITLE: TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM											
SIZE	SCALE	DRG. NO.	0000-211-POR-A-018							REV. NO.	RC
A4	NTS										

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RC	FOR TENDER PURPOSE	1/2	1/2	1/2	-	✓	-	-	-	AS	DATE
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	DATE
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	AS	DATE
REV. NO.	DESCRIPTION	FORWARD	FORWARD	CHD	M	E	C	C&I	ARCH	APPRO	DATE
Cleared By											
एन टी सी एल NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT											
STANDARD											
TITLE											
BRACKET FLOOR PLATE LIGHT DUTY.											
SIZE	SCALE	DRG. NO.							REV. NO.		
A4	NTS	0000-211-PDE-A-020							RC		

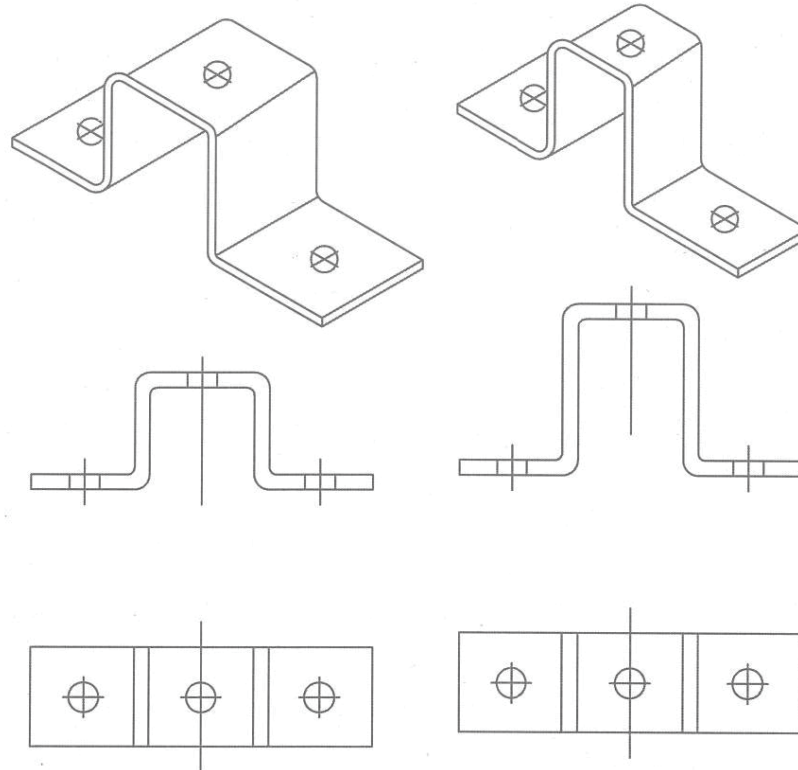
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NOTES:
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	A2	A3	VA	-	VV	-	-	-	AS	10/03/2018
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	10/03/2018
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	AS	10/03/2018
REV. NO.	DESCRIPTION	DESIGNED	CHECKED	DATE	M	E	C	CM	ARCH	APPRO	DATE
 NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE BRACKET FLOOR PLATE HEAVY DUTY.											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-021				REV. NO. RC					

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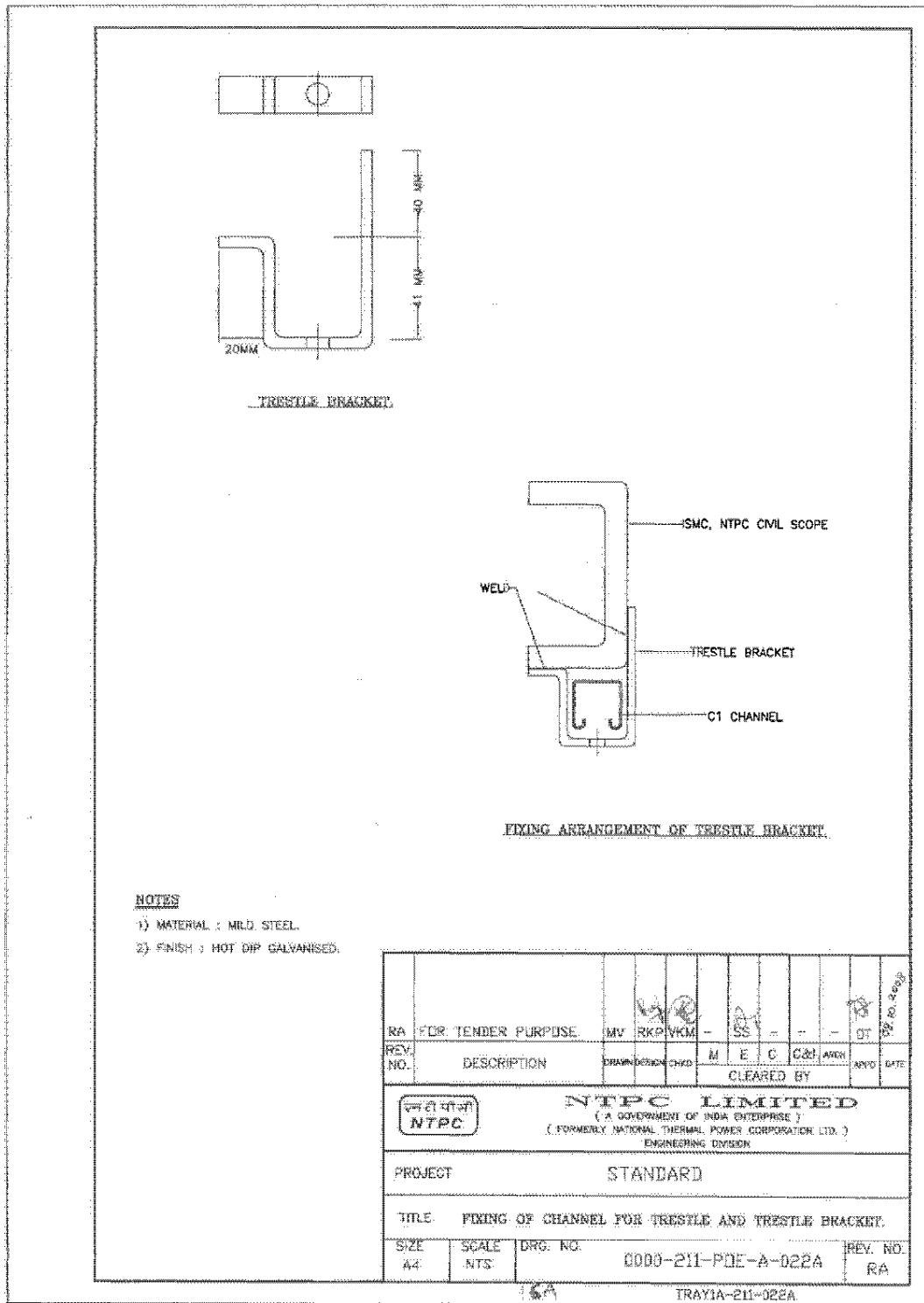


BRACKET-C1 CHANNEL CLAMP HEAVY DUTY.

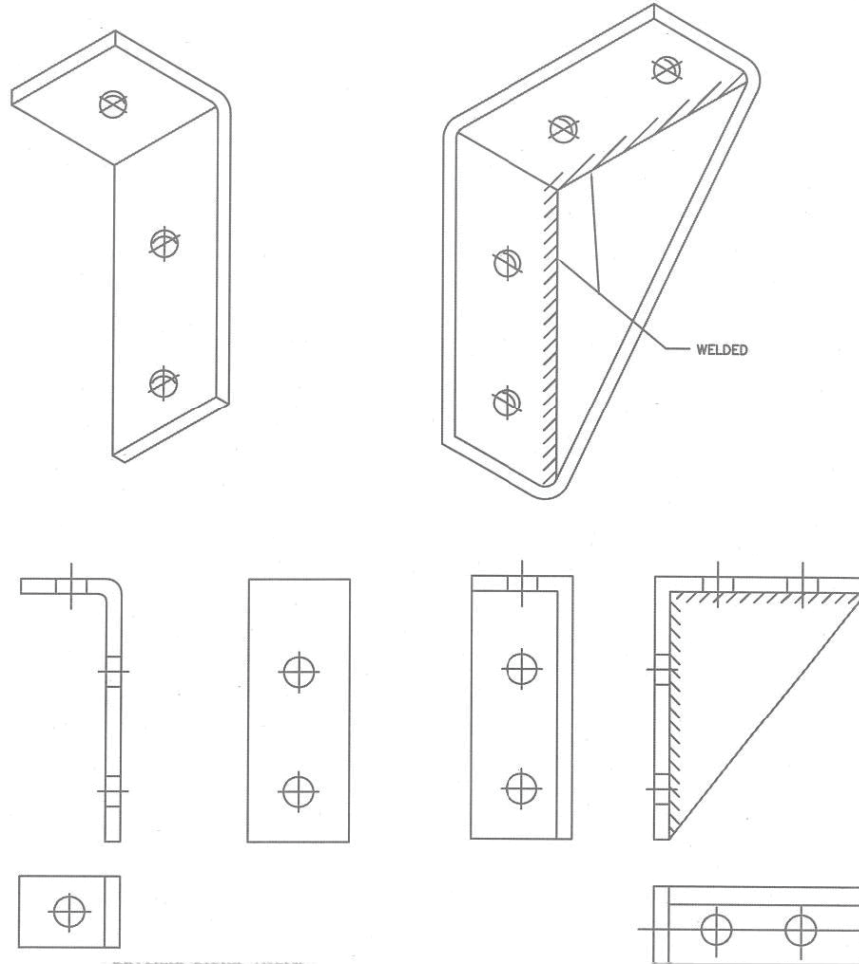
BRACKET-C2 CHANNEL CLAMP.

NOTES:
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	As	As	OK	-	✓	-	-	-	-	AS	10/10/20
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	-	AS	10/10/20
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	-	10/10/20
REV. NO.	DESCRIPTION	BRN	DESIGN	CHD	M	E	C	C&I	ARCH	APPS	DATE	
Cleared By												
 NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION												
PROJECT STANDARD												
TITLE BRACKET C1 CHANNEL CLAMP HEAVY DUTY. AND BRACKET C2 CHANNEL												
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-022								REV. NO. RC		



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NOTES:
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120	122	124	126	128	130	132	134	136	138	140	142	144	146	148	150	152	154	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234	236	238	240	242	244	246	248	250	252	254	256	258	260	262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296	298	300	302	304	306	308	310	312	314	316	318	320	322	324	326	328	330	332	334	336	338	340	342	344	346	348	350	352	354	356	358	360	362	364	366	368	370	372	374	376	378	380	382	384	386	388	390	392	394	396	398	400	402	404	406	408	410	412	414	416	418	420	422	424	426	428	430	432	434	436	438	440	442	444	446	448	450	452	454	456	458	460	462	464	466	468	470	472	474	476	478	480	482	484	486	488	490	492	494	496	498	500	502	504	506	508	510	512	514	516	518	520	522	524	526	528	530	532	534	536	538	540	542	544	546	548	550	552	554	556	558	560	562	564	566	568	570	572	574	576	578	580	582	584	586	588	590	592	594	596	598	600	602	604	606	608	610	612	614	616	618	620	622	624	626	628	630	632	634	636	638	640	642	644	646	648	650	652	654	656	658	660	662	664	666	668	670	672	674	676	678	680	682	684	686	688	690	692	694	696	698	700	702	704	706	708	710	712	714	716	718	720	722	724	726	728	730	732	734	736	738	740	742	744	746	748	750	752	754	756	758	760	762	764	766	768	770	772	774	776	778	780	782	784	786	788	790	792	794	796	798	800	802	804	806	808	810	812	814	816	818	820	822	824	826	828	830	832	834	836	838	840	842	844	846	848	850	852	854	856	858	860	862	864	866	868	870	872	874	876	878	880	882	884	886	888	890	892	894	896	898	900	902	904	906	908	910	912	914	916	918	920	922	924	926	928	930	932	934	936	938	940	942	944	946	948	950	952	954	956	958	960	962	964	966	968	970	972	974	976	978	980	982	984	986	988	990	992	994	996	998	1000	1002	1004	1006	1008	1010	1012	1014	1016	1018	1020	1022	1024	1026	1028	1030	1032	1034	1036	1038	1040	1042	1044	1046	1048	1050	1052	1054	1056	1058	1060	1062	1064	1066	1068	1070	1072	1074	1076	1078	1080	1082	1084	1086	1088	1090	1092	1094	1096	1098	1100	1102	1104	1106	1108	1110	1112	1114	1116	1118	1120	1122	1124	1126	1128	1130	1132	1134	1136	1138	1140	1142	1144	1146	1148	1150	1152	1154	1156	1158	1160	1162	1164	1166	1168	1170	1172	1174	1176	1178	1180	1182	1184	1186	1188	1190	1192	1194	1196	1198	1200	1202	1204	1206	1208	1210	1212	1214	1216	1218	1220	1222	1224	1226	1228	1230	1232	1234	1236	1238	1240	1242	1244	1246	1248	1250	1252	1254	1256	1258	1260	1262	1264	1266	1268	1270	1272	1274	1276	1278	1280	1282	1284	1286	1288	1290	1292	1294	1296	1298	1300	1302	1304	1306	1308	1310	1312	1314	1316	1318	1320	1322	1324	1326	1328	1330	1332	1334	1336	1338	1340	1342	1344	1346	1348	1350	1352	1354	1356	1358	1360	1362	1364	1366	1368	1370	1372	1374	1376	1378	1380	1382	1384	1386	1388	1390	1392	1394	1396	1398	1400	1402	1404	1406	1408	1410	1412	1414	1416	1418	1420	1422	1424	1426	1428	1430	1432	1434	1436	1438	1440	1442	1444	1446	1448	1450	1452	1454	1456	1458	1460	1462	1464	1466	1468	1470	1472	1474	1476	1478	1480	1482	1484	1486	1488	1490	1492	1494	1496	1498	1500	1502	1504	1506	1508	1510	1512	1514	1516	1518	1520	1522	1524	1526	1528	1530	1532	1534	1536	1538	1540	1542	1544	1546	1548	1550	1552	1554	1556	1558	1560	1562	1564	1566	1568	1570	1572	1574	1576	1578	1580	1582	1584	1586	1588	1590	1592	1594	1596	1598	1600	1602	1604	1606	1608	1610	1612	1614	1616	1618	1620	1622	1624	1626	1628	1630	1632	1634	1636	1638	1640	1642	1644	1646	1648	1650	1652	1654	1656	1658	1660	1662	1664	1666	1668	1670	1672	1674	1676	1678	1680	1682	1684	1686	1688	1690	1692	1694	1696	1698	1700	1702	1704	1706	1708	1710	1712	1714	1716	1718	1720	1722	1724	1726	1728	1730	1732	1734	1736	1738	1740	1742	1744	1746	1748	1750	1752	1754	1756	1758	1760	1762	1764	1766	1768	1770	1772	1774	1776	1778	1780	1782	1784	1786	1788	1790	1792	1794	1796	1798	1800	1802	1804	1806	1808	1810	1812	1814	1816	1818	1820	1822	1824	1826	1828	1830	1832	1834	1836	1838	1840	1842	1844	1846	1848	1850	1852	1854	1856	1858	1860	1862	1864	1866	1868	1870	1872	1874	1876	1878	1880	1882	1884	1886	1888	1890	1892	1894	1896	1898	1900	1902	1904	1906	1908	1910	1912	1914	1916	1918	1920	1922	1924	1926	1928	1930	1932	1934	1936	1938	1940	1942	1944	1946	1948	1950	1952	1954	1956	1958	1960	1962	1964	1966	1968	1970	1972	1974	1976	1978	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040	2042	2044	2046	2048	2050	2052	2054	2056	2058	2060	2062	2064	2066	2068	2070	2072	2074	2076	2078	2080	2082	2084	2086	2088	2090	2092	2094	2096	2098	2100	2102	2104	2106	2108	2110	2112	2114	2116	2118	2120	2122	2124	2126	2128	2130	2132	2134	2136	2138	2140	2142	2144	2146	2148	2150	2152	2154	2156	2158	2160	2162	2164	2166	2168	2170	2172	2174	2176	2178	2180	2182	2184	2186	2188	2190	2192	2194	2196	2198	2200	2202	2204	2206	2208	2210	2212	2214	2216	2218	2220	2222	2224	2226	2228	2230	2232	2234	2236	2238	2240	2242	2244	2246	2248	2250	2252	2254	2256	2258	2260	2262	2264	2266	2268	2270	2272	2274	2276	2278	2280	2282	2284	2286	2288	2290	2292	2294	2296	2298	2300	2302	2304	2306	2308	2310	2312	2314	2316	2318	2320	2322	2324	2326	2328	2330	2332	2334	2336	2338	2340	2342	2344	2346	2348	2350	2352	2354	2356	2358	2360	2362	2364	2366	2368	2370	2372	2374	2376	2378	2380	2382	2384	2386	2388	2390	2392	2394	2396	2398	2400	2402	2404	2406	2408	2410	2412	2414	2416	2418	2420	2422	2424	2426	2428	2430	2432	2434	2436	2438	2440	2442	2444	2446	2448	2450	2452	2454	2456	2458	2460	2462	2464	2466	2468	2470	2472	2474	2476	2478	2480	2482	2484	2486	2488	2490	2492	2494	2496	2498	2500	2502	2504	2506	2508	2510	2512	2514	2516	2518	2520	2522	2524	2526	2528	2530	2532	2534	2536	2538	2540	2542	2544	2546	2548	2550	2552	2554	2556	2558	2560	2562	2564	2566	2568	2570	2572	2574	2576	2578	2580	2582	2584	2586	2588	2590	2592	2594	2596	2598	2600	2602	2604	2606	2608	2610	2612	2614	2616	2618	2620	2622	2624	2626	2628	2630	2632	2634	2636	2638	2640	2642	2644	2646	2648	2650	2652	2654	2656	2658	2660	2662	2664	2666	2668	2670	2672	2674	2676	2678	2680	2682	2684	2686	2688	2690	2692	2694	2696	2698	2700	2702	2704	2706	2708	2710	2712	2714	2716	2718	2720	2722	2724	2726	2728	2730	2732	2734	2736	2738	2740	2742	2744	2746	2748	2750	2752	2754	2756	2758	2760	2762	2764	2766	2768	2770	2772	2774	2776	2778	2780	2782	2784	2786	2788	2790	2792	2794	2796	2798	2800	2802	2804	2806	2808	2810	2812	2814	2816	2818	2820	2822	2824	2826	2828	2830	2832	2834	2836	2838	2840	2842	2844	2846	2848	2850	2852	2854	2856	2858	2860	2862	2864	2866	2868	2870
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The image contains seven technical drawings of mechanical parts:

- Top Left:** An isometric view of a rectangular plate with a U-shaped bracket attached to its side. The plate has four holes on its top surface, arranged in a 2x2 grid.
- Middle Left:** A top view of a rectangular plate with four holes arranged in a 2x2 grid.
- Middle Right:** A side view of a rectangular plate, showing its thickness and the position of the holes.
- Bottom Left:** A cross-section view of a pin and bush assembly. The pin has a pointed end and a flat base. The bush is a hollow cylinder with a flange at one end.
- Bottom Center:** A side view of a pin and bush assembly, showing the pin passing through the bush.
- Bottom Right:** A U-bolt, which is a U-shaped bolt with threaded ends.
- Bottom Far Right:** A C-clamp, which is a U-shaped clamp with a threaded rod and a conical end.

RC	FOR TENDER PURPOSE	1/2	1/5	1/1	-	1/1	-	-	-	1/1	1/1
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	1/1
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	1/1
REV. NO.	DESCRIPTION	ISSUED	DESIGN	CHECK	M E C C&I ARCH					APPRO	DATE
		CLEARED BY									

एन टी सी एल
NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT : STANDARD

TITLE : BEAM CLAMP.

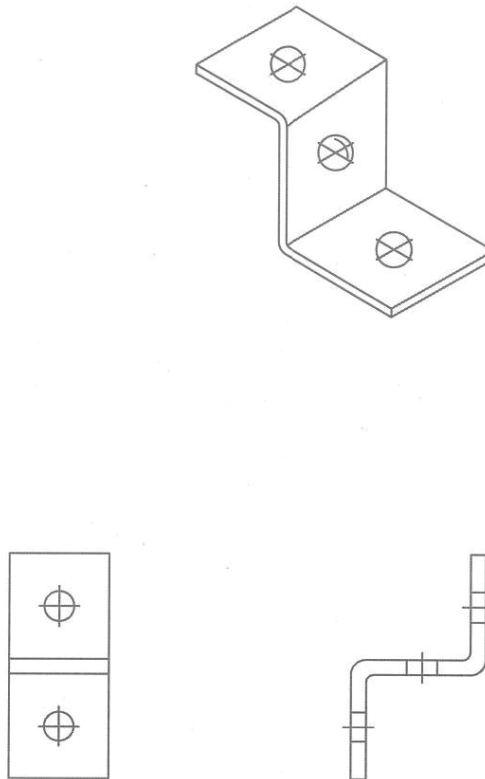
SIZE : A4

SCALE : NTS

DRG. NO. : 0000-211-PQE-A-024

REV. NO. : RC

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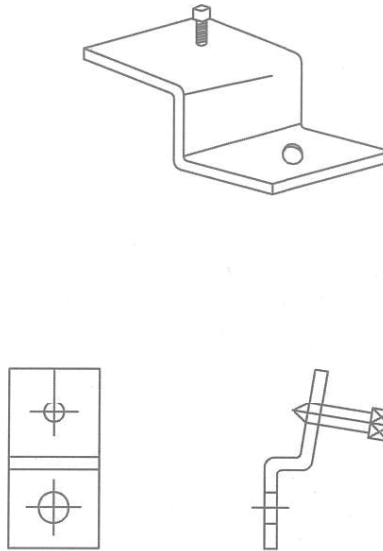


BRACKET-C1 CHANNEL CLAMP.

NOTES:
1. MATERIAL : MILD STEEL.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	M	M	DL	-	UN	-	-	-	AS	10/01/20
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	10/01/20
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	10/01/20
REV. NO.	DESCRIPTION	DESIGN	CHG	M	E	C	C&I	ARCH	APPD	DATE	
Cleared By											
एनटीपीसी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE BRACKET C1 CHANNEL CLAMP.											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-025							REV. NO. RC		

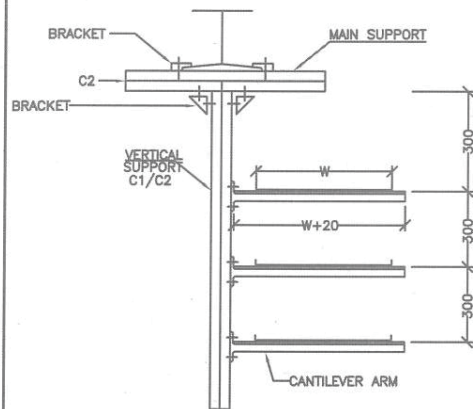
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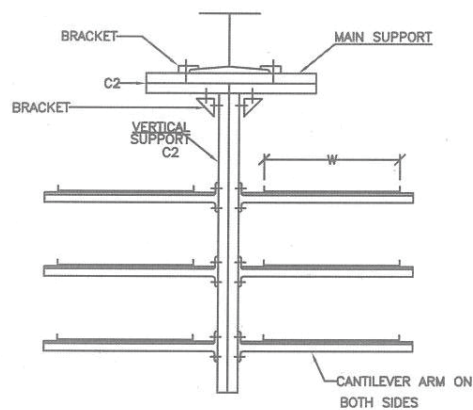
NOTES.
1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	Ag	ML	(V)	-	VV	-	-	-	AS	02-16
RB	FOR TENDER PURPOSE	DL	TL	SS	-	RA	-	-	-	AS	02-16
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	02-16
REV. NO.	DESCRIPTION	DESIGNED	CHECKED	DATE	M	E	C	C&I	ARCH	APPROV	DATE
CLEARED BY											
 NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE BRACKET BEAM CLAMP											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-026								REV. NO. RC	

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ARRANGEMENT TYPE-B1



ARRANGEMENT TYPE-B2

VERTICAL SUPPORT

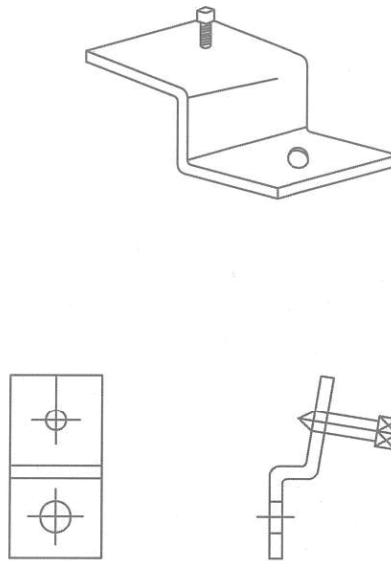
- 1) FOR 1 TO 6 TIER OF 600mm TRAY - C2 CHANNEL
- 2) FOR 1 TO 3 TIER OF 300mm TRAY - C1 CHANNEL
- 3) FOR 4 TO 6 TIER OF 300mm TRAY - C2 CHANNEL
- 4) FOR 1 TO 6 TIER OF 150mm TRAY - C1 CHANNEL

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. IN CASE OF HANGING SUPPORT C2 CHANNEL TO BE USED FOR MAIN SUPPORT

RC	FOR TENDER PURPOSE	MS	MS	DR	-	W	-	-	-	MS-25
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	MS
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	MS-25
REV. NO.	DESCRIPTION	DESIGNER	CHECKED	CHG	M	E	C	C&I	ARCH	APPD DATE
					CLEARED BY					
		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION								
PROJECT		STANDARD								
TITLE		STANDARD CABLE SUPPORT ASSEMBLY								
SIZE	SCALE	DRG. NO.							REV. NO.	
A4	NTS	0000-211-PQE-A-030							RC	

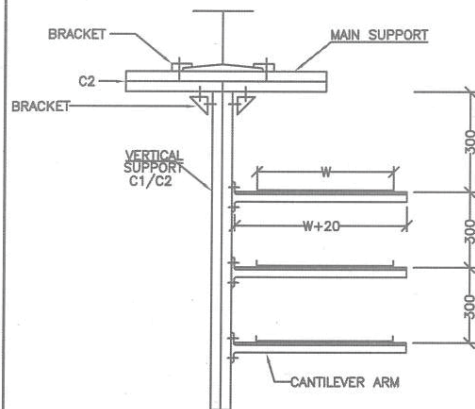
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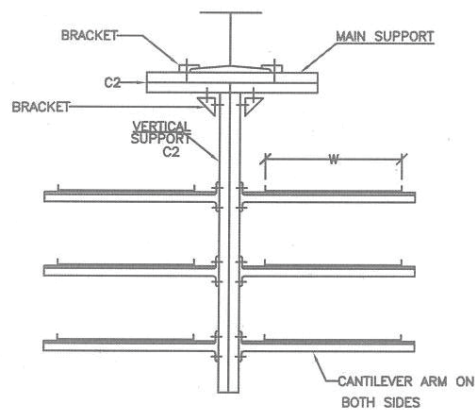
NOTES.
1. MATERIAL : MILD STEEL.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	AS	DL	SS	-	RA	-	-	-	AS	10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	10
REV. NO.	DESCRIPTION	DR	DESIGN	CHD	M	E	C	C&I	ARCH	APPD	DATE
 NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT: STANDARD											
TITLE: BRACKET BEAM CLAMP											
SIZE: A4	SCALE: NTS	DRG. NO. 0000-211-PDE-A-026								REV. NO. RC	

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ARRANGEMENT TYPE-B1



ARRANGEMENT TYPE-B2

VERTICAL SUPPORT

- 1) FOR 1 TO 6 TIER OF 600mm TRAY - C2 CHANNEL
- 2) FOR 1 TO 3 TIER OF 300mm TRAY - C1 CHANNEL
- 3) FOR 4 TO 6 TIER OF 300mm TRAY - C2 CHANNEL
- 4) FOR 1 TO 6 TIER OF 150mm TRAY - C1 CHANNEL

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. IN CASE OF HANGING SUPPORT C2 CHANNEL TO BE USED FOR MAIN SUPPORT

RC	FOR TENDER PURPOSE	AS	AS	DL	-	W	-	-	-	AS	MA
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	MA
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	MA
REV. NO.	DESCRIPTION	DESIGN	DESIGN	CHD	M	E	C	C&J	ARCH	APPRO	DATE
Cleared By											



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ENGINEERING DIVISION

PROJECT		STANDARD	
TITLE		STANDARD CABLE SUPPORT ASSEMBLY	
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-030	REV. NO. RC

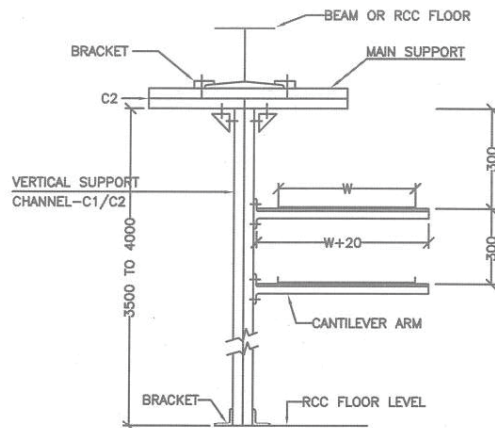
RC	FOR TENDER PURPOSE	1/2	1/3	1/4	-	1/5	-	-	-	1/6	1/7
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	1/8
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	1/9
REV. NO.	DESCRIPTION	DRWING	DESIGN	CHD	M	E	C	Col	ARCH	APPS	DATE
CLEARED BY											

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ENGINEERING DIVISION

PROJECT	STANDARD
TITLE	STANDARD CABLE SUPPORT ASSEMBLY
SIZE A4	SCALE NTS
DRG. NO.	0000-211-PDE-A-031
REV. NO. RC	

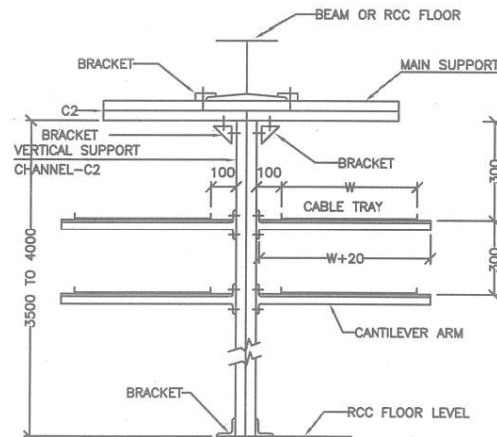
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VERTICAL SUPPORT

- 1) UPTO 3 TIER - C1 CHANNEL
- 2) ABOVE 3 TIER - C2 CHANNEL

ARRANGEMENT TYPE-D1



ARRANGEMENT TYPE-D2

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED.
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

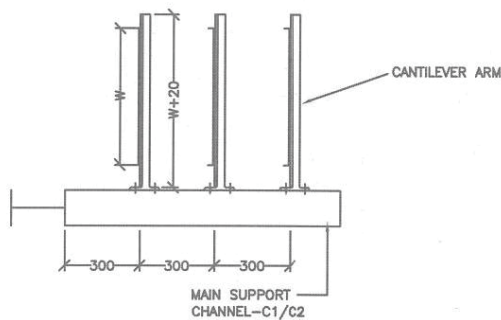
RC	FOR TENDER PURPOSE	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	1/32	1/33	1/34	1/35	1/36	1/37	1/38	1/39	1/40	1/41	1/42	1/43	1/44	1/45	1/46	1/47	1/48	1/49	1/50	1/51	1/52	1/53	1/54	1/55	1/56	1/57	1/58	1/59	1/60	1/61	1/62	1/63	1/64	1/65	1/66	1/67	1/68	1/69	1/70	1/71	1/72	1/73	1/74	1/75	1/76	1/77	1/78	1/79	1/80	1/81	1/82	1/83	1/84	1/85	1/86	1/87	1/88	1/89	1/90	1/91	1/92	1/93	1/94	1/95	1/96	1/97	1/98	1/99	1/100	1/101	1/102	1/103	1/104	1/105	1/106	1/107	1/108	1/109	1/110	1/111	1/112	1/113	1/114	1/115	1/116	1/117	1/118	1/119	1/120	1/121	1/122	1/123	1/124	1/125	1/126	1/127	1/128	1/129	1/130	1/131	1/132	1/133	1/134	1/135	1/136	1/137	1/138	1/139	1/140	1/141	1/142	1/143	1/144	1/145	1/146	1/147	1/148	1/149	1/150	1/151	1/152	1/153	1/154	1/155	1/156	1/157	1/158	1/159	1/160	1/161	1/162	1/163	1/164	1/165	1/166	1/167	1/168	1/169	1/170	1/171	1/172	1/173	1/174	1/175	1/176	1/177	1/178	1/179	1/180	1/181	1/182	1/183	1/184	1/185	1/186	1/187	1/188	1/189	1/190	1/191	1/192	1/193	1/194	1/195	1/196	1/197	1/198	1/199	1/200	1/201	1/202	1/203	1/204	1/205	1/206	1/207	1/208	1/209	1/210	1/211	1/212	1/213	1/214	1/215	1/216	1/217	1/218	1/219	1/220	1/221	1/222	1/223	1/224	1/225	1/226	1/227	1/228	1/229	1/230	1/231	1/232	1/233	1/234	1/235	1/236	1/237	1/238	1/239	1/240	1/241	1/242	1/243	1/244	1/245	1/246	1/247	1/248	1/249	1/250	1/251	1/252	1/253	1/254	1/255	1/256	1/257	1/258	1/259	1/260	1/261	1/262	1/263	1/264	1/265	1/266	1/267	1/268	1/269	1/270	1/271	1/272	1/273	1/274	1/275	1/276	1/277	1/278	1/279	1/280	1/281	1/282	1/283	1/284	1/285	1/286	1/287	1/288	1/289	1/290	1/291	1/292	1/293	1/294	1/295	1/296	1/297	1/298	1/299	1/300	1/301	1/302	1/303	1/304	1/305	1/306	1/307	1/308	1/309	1/310	1/311	1/312	1/313	1/314	1/315	1/316	1/317	1/318	1/319	1/320	1/321	1/322	1/323	1/324	1/325	1/326	1/327	1/328	1/329	1/330	1/331	1/332	1/333	1/334	1/335	1/336	1/337	1/338	1/339	1/340	1/341	1/342	1/343	1/344	1/345	1/346	1/347	1/348	1/349	1/350	1/351	1/352	1/353	1/354	1/355	1/356	1/357	1/358	1/359	1/360	1/361	1/362	1/363	1/364	1/365	1/366	1/367	1/368	1/369	1/370	1/371	1/372	1/373	1/374	1/375	1/376	1/377	1/378	1/379	1/380	1/381	1/382	1/383	1/384	1/385	1/386	1/387	1/388	1/389	1/390	1/391	1/392	1/393	1/394	1/395	1/396	1/397	1/398	1/399	1/400	1/401	1/402	1/403	1/404	1/405	1/406	1/407	1/408	1/409	1/410	1/411	1/412	1/413	1/414	1/415	1/416	1/417	1/418	1/419	1/420	1/421	1/422	1/423	1/424	1/425	1/426	1/427	1/428	1/429	1/430	1/431	1/432	1/433	1/434	1/435	1/436	1/437	1/438	1/439	1/440	1/441	1/442	1/443	1/444	1/445	1/446	1/447	1/448	1/449	1/450	1/451	1/452	1/453	1/454	1/455	1/456	1/457	1/458	1/459	1/460	1/461	1/462	1/463	1/464	1/465	1/466	1/467	1/468	1/469	1/470	1/471	1/472	1/473	1/474	1/475	1/476	1/477	1/478	1/479	1/480	1/481	1/482	1/483	1/484	1/485	1/486	1/487	1/488	1/489	1/490	1/491	1/492	1/493	1/494	1/495	1/496	1/497	1/498	1/499	1/500	1/501	1/502	1/503	1/504	1/505	1/506	1/507	1/508	1/509	1/510	1/511	1/512	1/513	1/514	1/515	1/516	1/517	1/518	1/519	1/520	1/521	1/522	1/523	1/524	1/525	1/526	1/527	1/528	1/529	1/530	1/531	1/532	1/533	1/534	1/535	1/536	1/537	1/538	1/539	1/540	1/541	1/542	1/543	1/544	1/545	1/546	1/547	1/548	1/549	1/550	1/551	1/552	1/553	1/554	1/555	1/556	1/557	1/558	1/559	1/560	1/561	1/562	1/563	1/564	1/565	1/566	1/567	1/568	1/569	1/570	1/571	1/572	1/573	1/574	1/575	1/576	1/577	1/578	1/579	1/580	1/581	1/582	1/583	1/584	1/585	1/586	1/587	1/588	1/589	1/590	1/591	1/592	1/593	1/594	1/595	1/596	1/597	1/598	1/599	1/600	1/601	1/602	1/603	1/604	1/605	1/606	1/607	1/608	1/609	1/610	1/611	1/612	1/613	1/614	1/615	1/616	1/617	1/618	1/619	1/620	1/621	1/622	1/623	1/624	1/625	1/626	1/627	1/628	1/629	1/630	1/631	1/632	1/633	1/634	1/635	1/636	1/637	1/638	1/639	1/640	1/641	1/642	1/643	1/644	1/645	1/646	1/647	1/648	1/649	1/650	1/651	1/652	1/653	1/654	1/655	1/656	1/657	1/658	1/659	1/660	1/661	1/662	1/663	1/664	1/665	1/666	1/667	1/668	1/669	1/670	1/671	1/672	1/673	1/674	1/675	1/676	1/677	1/678	1/679	1/680	1/681	1/682	1/683	1/684	1/685	1/686	1/687	1/688	1/689	1/690	1/691	1/692	1/693	1/694	1/695	1/696	1/697	1/698	1/699	1/700	1/701	1/702	1/703	1/704	1/705	1/706	1/707	1/708	1/709	1/710	1/711	1/712	1/713	1/714	1/715	1/716	1/717	1/718	1/719	1/720	1/721	1/722	1/723	1/724	1/725	1/726	1/727	1/728	1/729	1/730	1/731	1/732	1/733	1/734	1/735	1/736	1/737	1/738	1/739	1/740	1/741	1/742	1/743	1/744	1/745	1/746	1/747	1/748	1/749	1/750	1/751	1/752	1/753	1/754	1/755	1/756	1/757	1/758	1/759	1/760	1/761	1/762	1/763	1/764	1/765	1/766	1/767	1/768	1/769	1/770	1/771	1/772	1/773	1/774	1/775	1/776	1/777	1/778	1/779	1/780	1/781	1/782	1/783	1/784	1/785	1/786	1/787	1/788	1/789	1/790	1/791	1/792	1/793	1/794	1/795	1/796	1/797	1/798	1/799	1/800	1/801	1/802	1/803	1/804	1/805	1/806	1/807	1/808	1/809	1/810	1/811	1/812	1/813	1/814	1/815	1/816	1/817	1/818	1/819	1/820	1/821	1/822	1/823	1/824	1/825	1/826	1/827	1/828	1/829	1/830	1/831	1/832	1/833	1/834	1/835	1/836	1/837	1/838	1/839	1/840	1/841	1/842	1/843	1/844	1/845	1/846	1/847	1/848	1/849	1/850	1/851	1/852	1/853	1/854	1/855	1/856	1/857	1/858	1/859	1/860	1/861	1/862	1/863	1/864	1/865	1/866	1/867	1/868	1/869	1/870	1/871	1/872	1/873	1/874	1/875	1/876	1/877	1/878	1/879	1/880	1/881	1/882	1/883	1/884	1/885	1/886	1/887	1/888	1/889	1/890	1/891	1/892	1/893	1/894	1/895	1/896	1/897	1/898	1/899	1/900	1/901	1/902	1/903	1/904	1/905	1/906	1/907	1/908	1/909	1/910	1/911	1/912	1/913	1/914	1/915	1/916	1/917	1/918	1/919	1/920	1/921	1/922	1/923	1/924	1/925	1/926	1/927	1/928	1/929	1/930	1/931	1/932	1/933	1/934	1/935	1/936	1/937	1/938	1/939	1/940	1/941	1/942	1/943	1/944	1/945	1/946	1/947	1/948	1/949	1/950	1/951	1/952	1/953	1/954	1/955	1/956	1/957	1/958	1/959	1/960	1/961	1/962	1/963	1/964	1/965	1/966	1/967	1/968	1/969	1/970	1/971	1/972	1/973	1/974	1/975	1/976	1/977	1/978	1/979	1/980	1/981	1/982	1/983	1/984	1/985	1/986	1/987	1/988	1/989	1/990	1/991	1/992	1/993	1/994	1/995	1/996	1/997	1/998	1/999	1/1000	1/1001	1/1002	1/1003	1/1004	1/1005	1/1006	1/1007	1/1008	1/1009	1/1010	1/1011	1/1012	1/1013	1/1014	1/1015	1/1016	1/1017	1/1018	1/1019	1/1020	1/1021	1/1022	1/1023	1/1024	1/1025	1/1026	1/1027	1/1028	1/1029	1/1030	1/1031	1/1032	1/1033	1/1034	1/1035	1/1036	1/1037	1/1038	1/1039	1/1040	1/1041	1/1042	1/1043	1/1044	1/1045	1/1046	1/1047	1/1048	1/1049	1/1050	1/1051	1/1052	1/1053	1/1054	1/1055	1/1056	1/1057	1/1058	1/1059	1/1060	1/1061	1/1062	1/1063	1/1064	1/1065	1/1066	1/1067	1/1068	1/1069	1/1070	1/1071	1/1072	1/1073	1/1074	1/1075	1/1076	1/1077	1/1078	1/1079	1/1080	1/1081	1/1082	1/1083	1/1084	1/1085	1/1086	1/1087	1/1088	1/1089	1/1090	1/1091	1/1092	1/1093	1/1094	1/1095	1/1096	1/1097	1/1098	1/1099	1/1100	1/1101	1/1102	1/1103	1/1104	1/1105	1/1106	1/1107	1/1108	1/1109	1/1110	1/1111	1/1112	1/1113	1/1114	1/1115	1/1116	1/1117	1/1118	1/1119	1/1120	1/1121	1/1122	1/1123	1/1124	1/1125	1/1126	1/1127	1/1128	1/1129	1/1130	1/1131	1/1132	1/1133	1/1134	1/1135	1/1136	1/1137	1/1138	1/1139	1/1140	1/1141	1/1142	1/1143	1/1144	1/1145	1/1146	1/1147	1/1148	1/1149	1/1150	1/1151	1/1152	1/1153	1/1154	1/1155	1/1156	1/1157	1/1158	1/1159	1/1160	1/1161	1/1162	1/1163	1/1164	1/1165	1/1166	1/1167	1/1168	1/1169	1/1170	1/1171	1/1172	1/1173	1/1174	1/1175	1/1176	1/1177	1/1178	1/1179	1/1180	1/1181	1/1182	1/1183	1/1184	1/1185	1/1186	1/1187	1/1188	1/1189	1/1190	1/1191	1/1192	1/1193	1/1194	1/1195	1/1196	1/1197	1/1198	1/1199	1/1200	1/1201	1/1202	1/1203	1/1204	1/1205	1/1206	1/1207	1/1208	1/1209	1/1210	1/1211	1/1212	1/1213	1/1214	1/1215	1/1216	1/1217	1/1218	1/1219	1/1220	1/1221	1/1222	1/1223	1/1224	1/1225	
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RC	FDR TENDER PURPOSE	A2	A3	W4	-	W4	-	-	-	AS	REV. NO.
RB	FDR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	REV. NO.
RA	FDR TENDER PURPOSE	-	-	-	-	-	-	-	-	AS	REV. NO.
REV. NO.	DESCRIPTION	DRWING	DESIGN	CHD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		STANDARD CABLE SUPPORT ASSEMBLY									
SIZE	SCALE	DRG. NO.								REV. NO.	
A4	NTS	0000-211-PDE-A-033								RC	

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MAIN SUPPORT

- 1) FOR 1 TO 6 TIER OF 600mm TRAY - C2 CHANNEL
- 2) FOR 1 TO 3 TIER OF 300mm TRAY - C1 CHANNEL
- 3) FOR 4 TO 6 TIER OF 300mm TRAY - C2 CHANNEL
- 4) FOR 1 TO 6 TIER OF 150mm TRAY - C1 CHANNEL



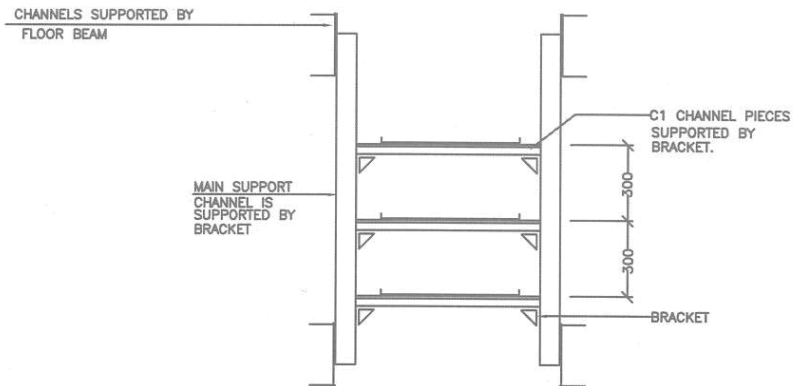
ARRANGEMENT TYPE-S2

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED.
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

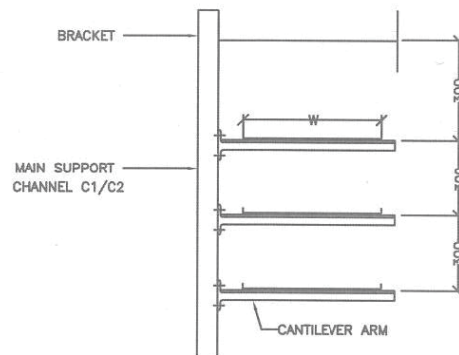
RC	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	AS
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	AS
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	AS
REV. NO.	DESCRIPTION	DRW	DESIGN	CHD	M	E	C	C&I	ARCH	APPR	DATE
Cleared By											
एनटीपीसी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION											
PROJECT STANDARD											
TITLE STANDARD CABLE SUPPORT ASSEMBLY											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-034								REV. NO. RC	

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ARRANGEMENT TYPE-S3

- MAIN SUPPORT**
- 1) UPTO 3 TIER - C1 CHANNEL
 - 2) ABOVE 3 TIER - C2 CHANNEL

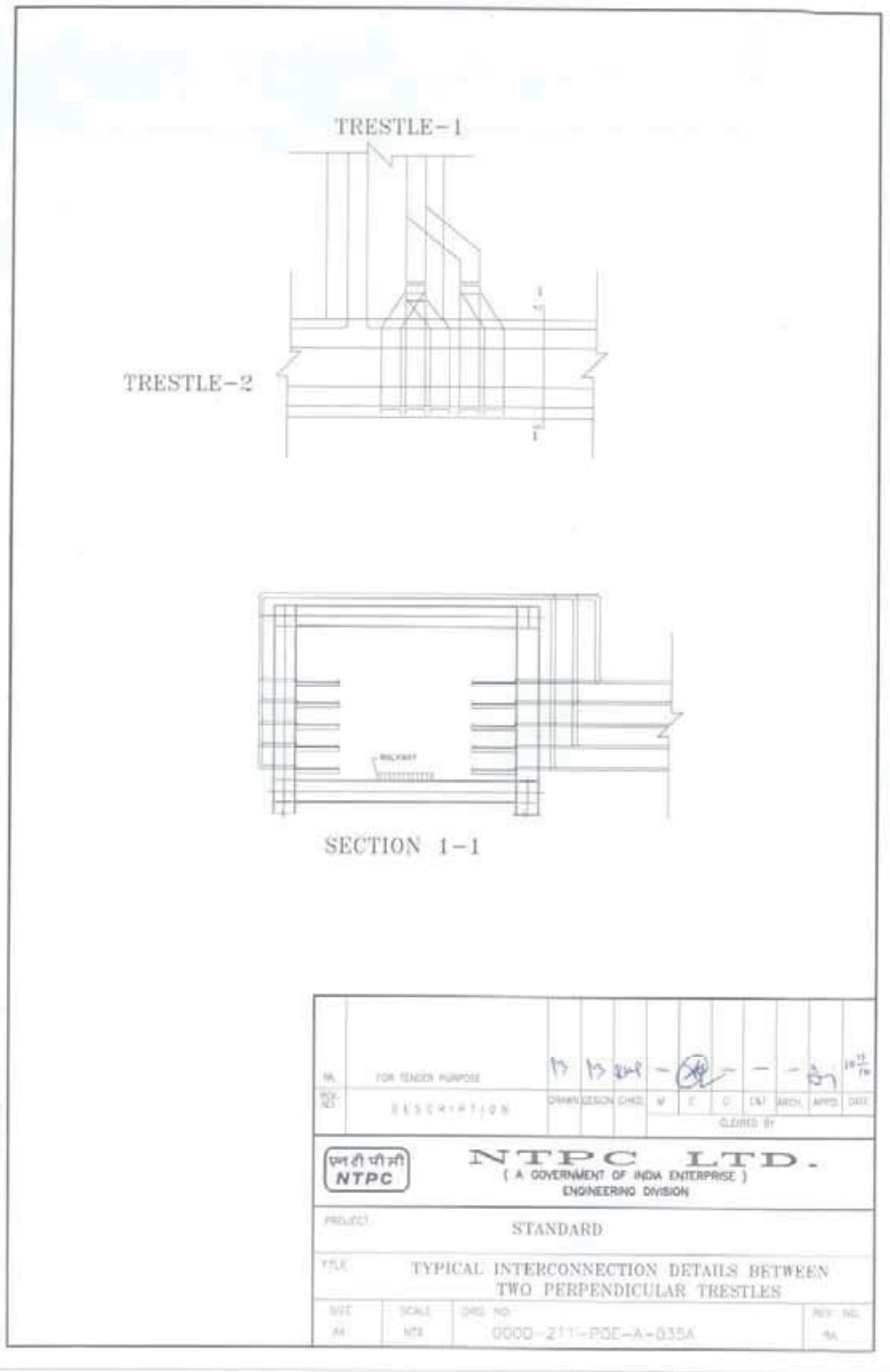


ARRANGEMENT TYPE-S4

- NOTES.**
1. ALL DIMENSIONS ARE IN mm.
 2. MATERIAL : MS SHEET.
 3. FINISH : HOT DIP GALVANIZED
 4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

RC	FOR TENDER PURPOSE	1/2	1/2	2/4	-	4/4	-	-	-	-	-	AS	AS
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	-	-	AS	AS
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	-	-	AS
REV. NO.	DESCRIPTION	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE
एनटीपीसी NTPC NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION													
PROJECT STANDARD													
TITLE STANDARD CABLE SUPPORT ASSEMBLY													
SIZE	SCALE	DRG. NO.	0000-211-PDE-A-035								REV. NO.	RC	
A4	NTS												

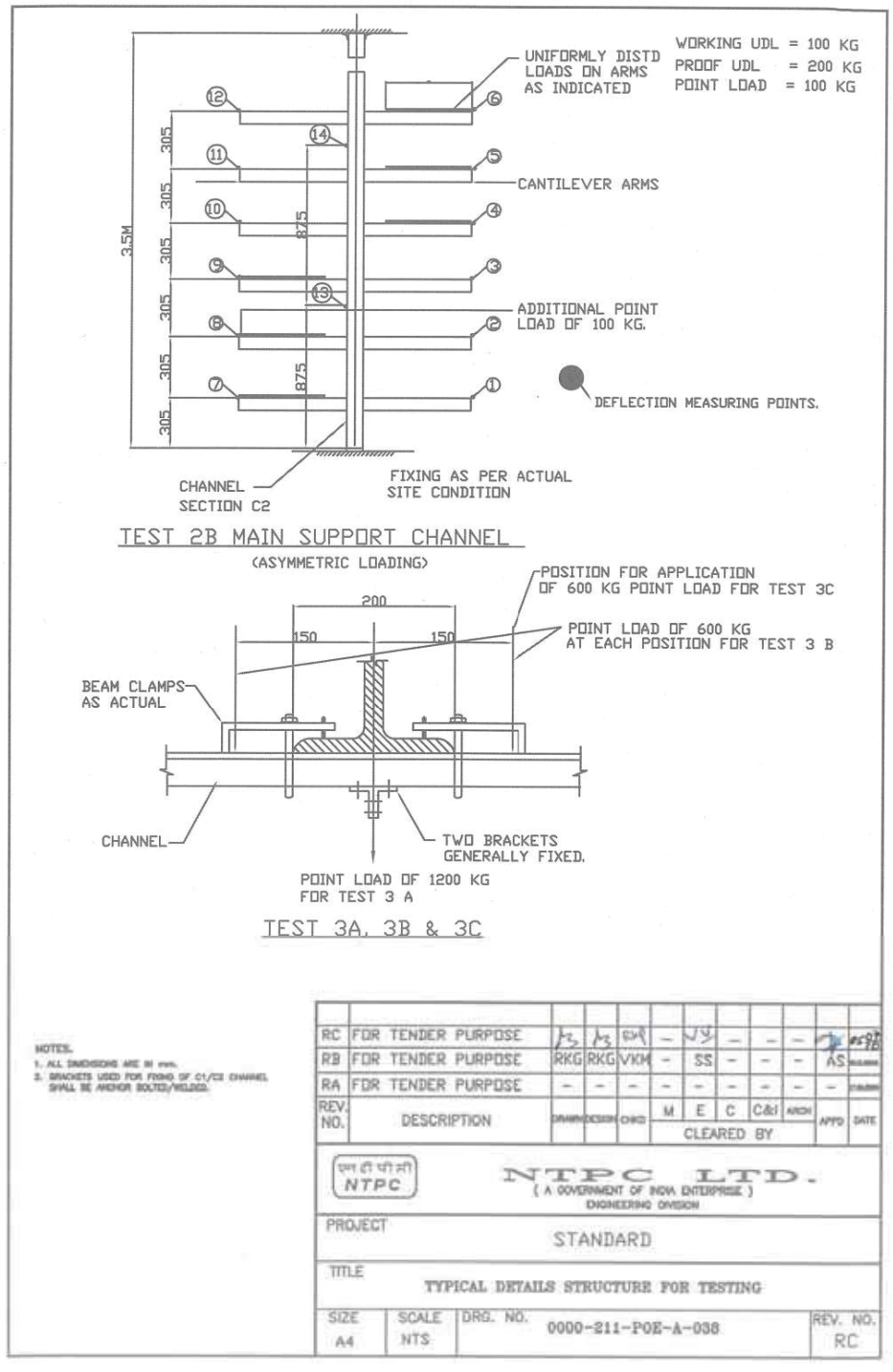
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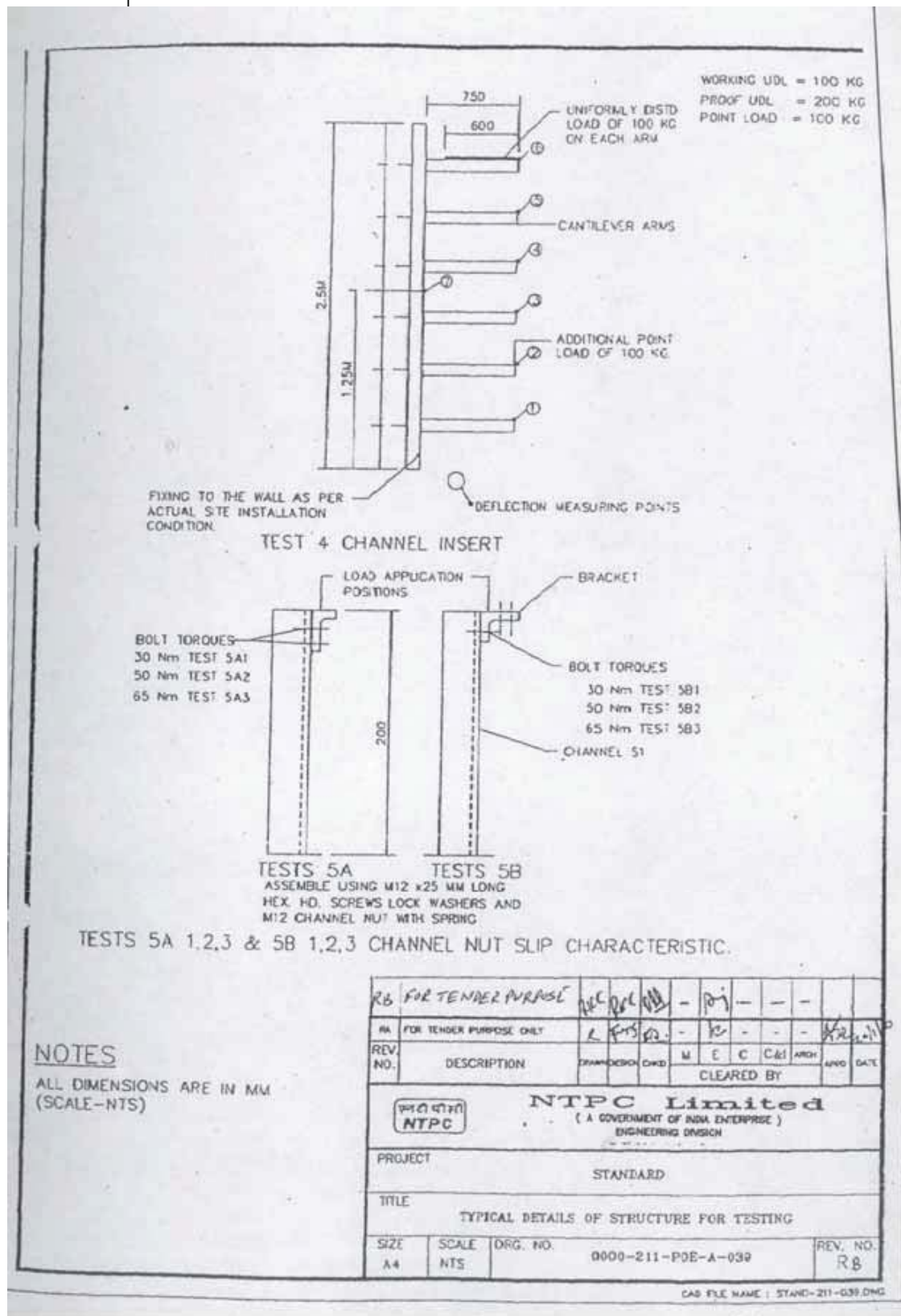




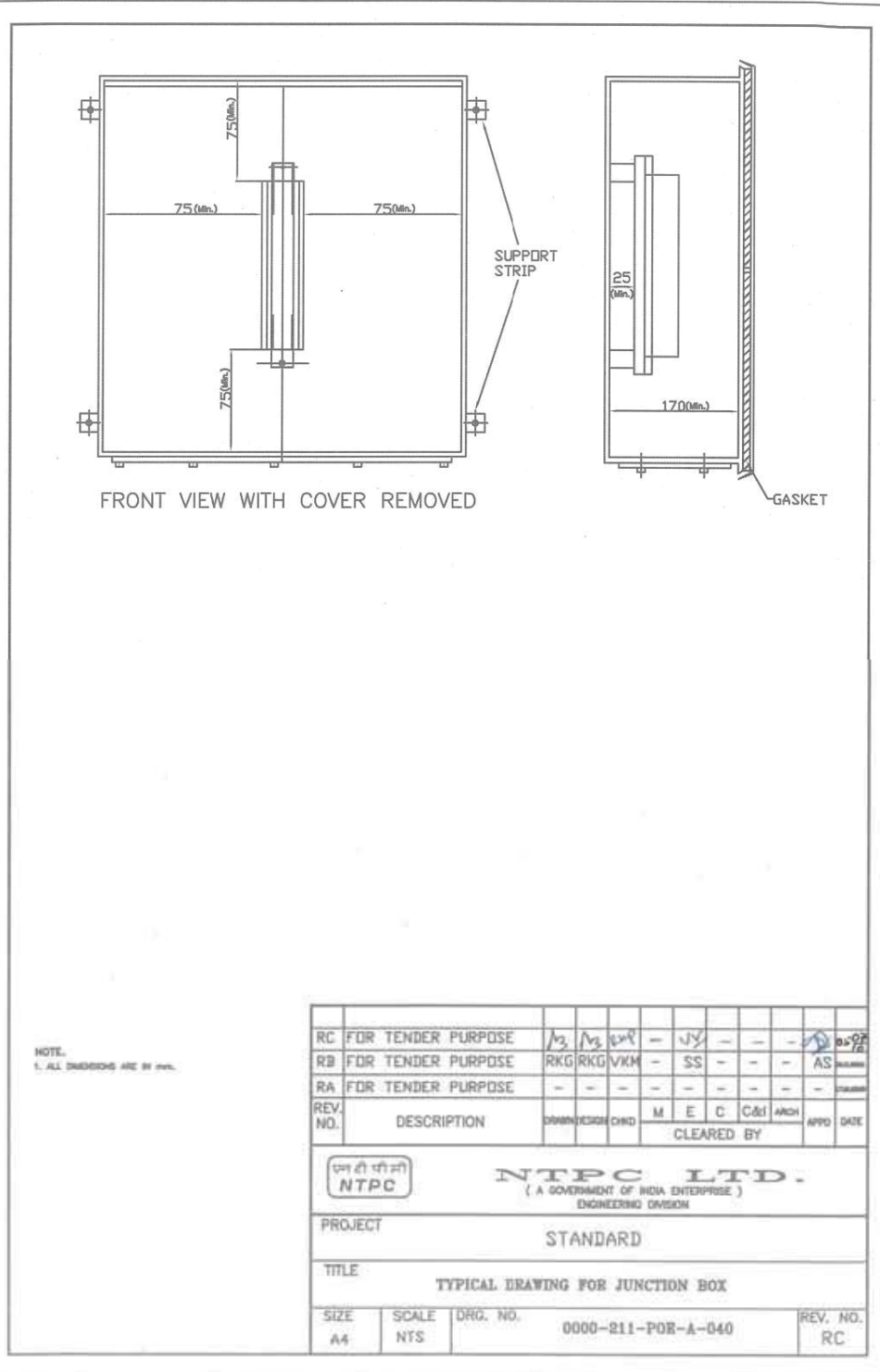


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Technical drawing showing earthing details. The top part shows a cross-section of a retaining wall with a floor slab, earth grid, and an MS water stop (150x150x3) welded to the main earthing conductor grid outside the building. The bottom part shows a detail of an earth riser welded to the main earth conductor embedded in an RCC floor slab. Labels include: FLOOR SLAB, 50 MIN., EARTH GRID, MS WATER STOP (150x150x3), REFER DETAIL 'A', MAIN EARTHING CONDUCTOR GRID OUTSIDE THE BLDG., INSERT IN RETAINING WALL, DETAIL 'A', EARTH RISER WELDED TO MAIN EARTH CONDUCTOR EMBEDDED IN CONCRETE., RCC FLOOR SLAB, 50 MIN., and EARTH RISER.

EQUIPMENT GROUNDING WITH G.S. FLAT

EQUIPMENT GROUNDING WITH G.S. WIRE

MOTOR TERMINAL BOX GROUNDING DETAIL

LAP JOINTS BETWEEN G.S. FLATS

ANGULAR JOINTS BETWEEN G.S. FLATS

NOTE:
1. ALL DIMENSIONS ARE IN MM.

RC	FOR TENDER PURPOSE	1/2	1/3	Rvt	-	NV	-	-	-	-	-	-	-	-	-	-
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	-	-	-	-	-	-	-
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REV. NO.	DESCRIPTION	DIV	DESIGN	CHECK	M	E	C	C&I	ARCH	APPD	DATE					
Cleared By																

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PROJECT STANDARD

TITLE EARTHING DETAILS

SIZE A4 SCALE NTS DRG. NO. 0000-211-P08-A-042 REV. NO. RC

CROSS JOINTS BETWEEN FLATS

Diagram showing G.S. FLAT and ARC WELD. Section 2-2.

BONDING OF STEEL COLUMN

Diagram showing STEEL COLUMN, GROUND JUMPER 25x6 G.S. FLAT, and ARC WELD. Section 6-6.

GROUND CONDUCTOR ALONG BUILDING WALL

Diagram showing BUILDING WALL, 25x6 G.S. FLAT, G.S. FIXING CLEAT, and dimension 750. Section 4-4.

GROUND CONDUCTOR ALONG STEEL COLUMN STRUCTURE

Diagram showing GROUND CONDUCTOR 25x6 G.S. FLAT, dimension 1000 (TYP), and STEEL COLUMN. Section 5-5.

NOTE:
1. ALL DIMENSIONS ARE IN mm.

RC	FOR TENDER PURPOSE	R/K	R/K	V/K	-	SS	-	-	-	AS	DATE
RB	FOR TENDER PURPOSE	R/K	R/K	V/K	-	SS	-	-	-	AS	DATE
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	DATE
REV. NO.	DESCRIPTION	CHANGED	CHANGED	CHANGED	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						

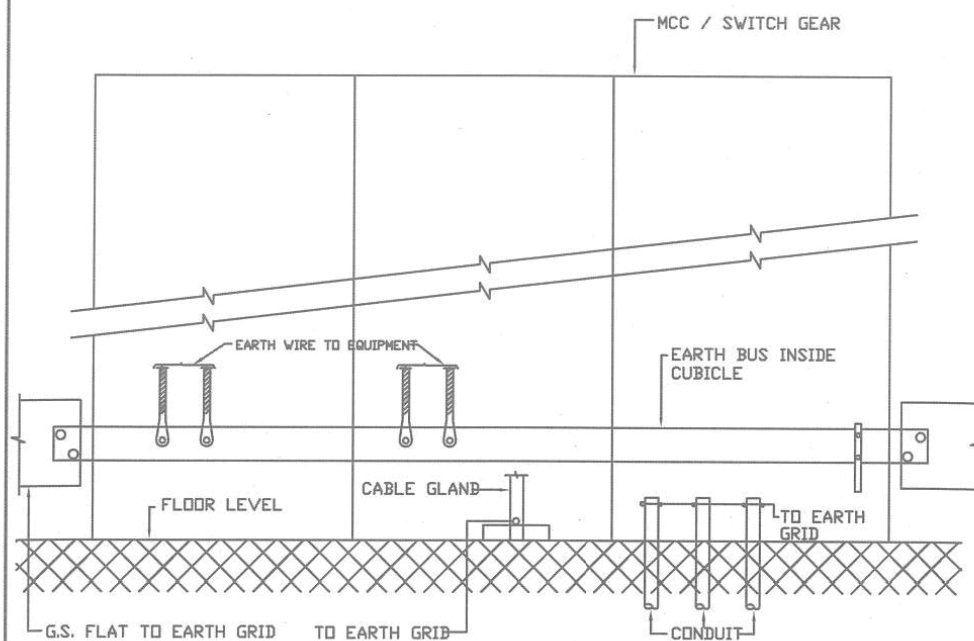
NTPC
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PROJECT
STANDARD

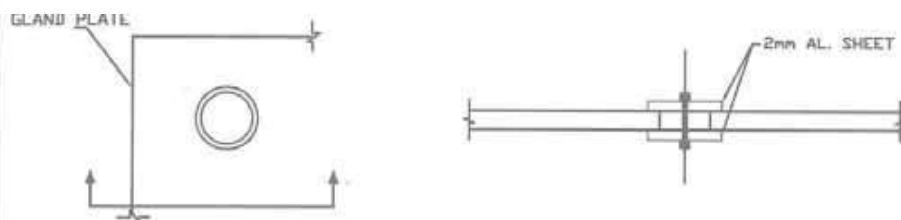
TITLE
EARTHING DETAILS

SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-043	REV. NO. RC
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EARTHING DETAILS MCC AND SWITCHGEAR

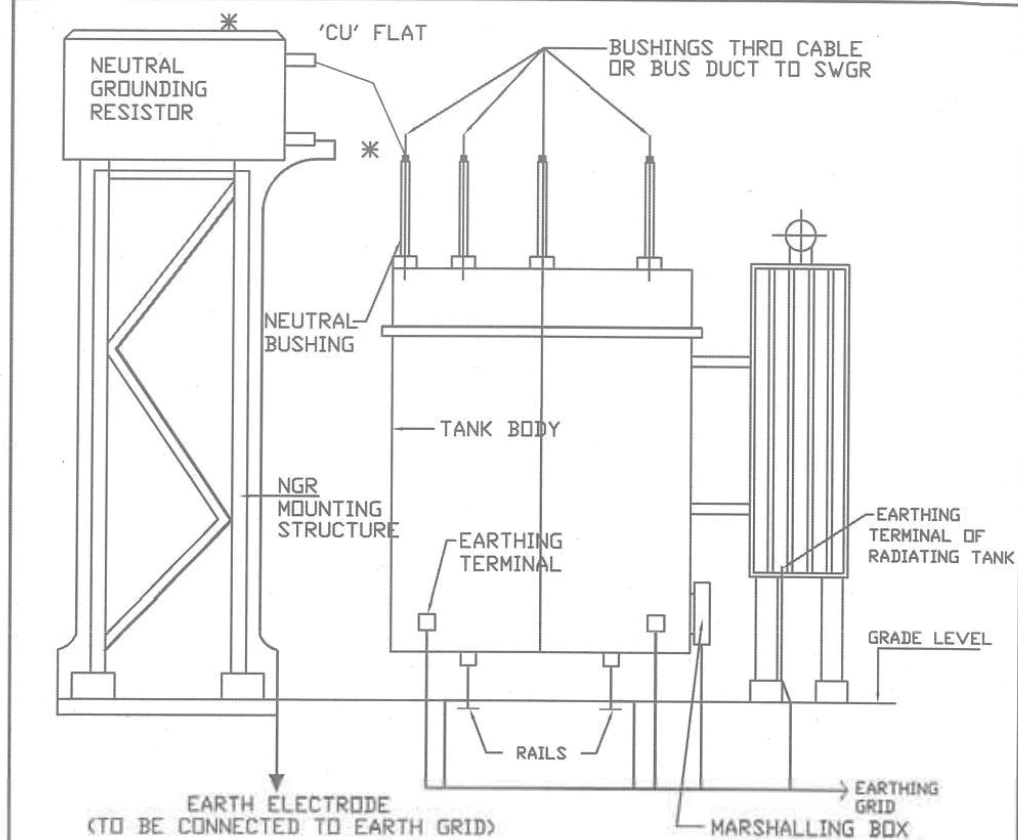


SEALING OF UNUSED CABLE OPENING

NOTE:
1. ALL DIMENSIONS ARE IN mm.

RC	FOR TENDER PURPOSE	As	As	As	-	NY	-	-	-	AS	AS
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	AS
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	AS
REV. NO.	DESCRIPTION	QUANTITY	DESCRIPTION	UNIT	M	E	C	C&I	ARCH	APPRO	SAT
CLEARED BY											
		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT											
STANDARD											
TITLE											
EARTHING DETAILS											
SIZE A4	SCALE NTS	DRG. NO.	0000-211-POR-A-044							REV. NO. RC	

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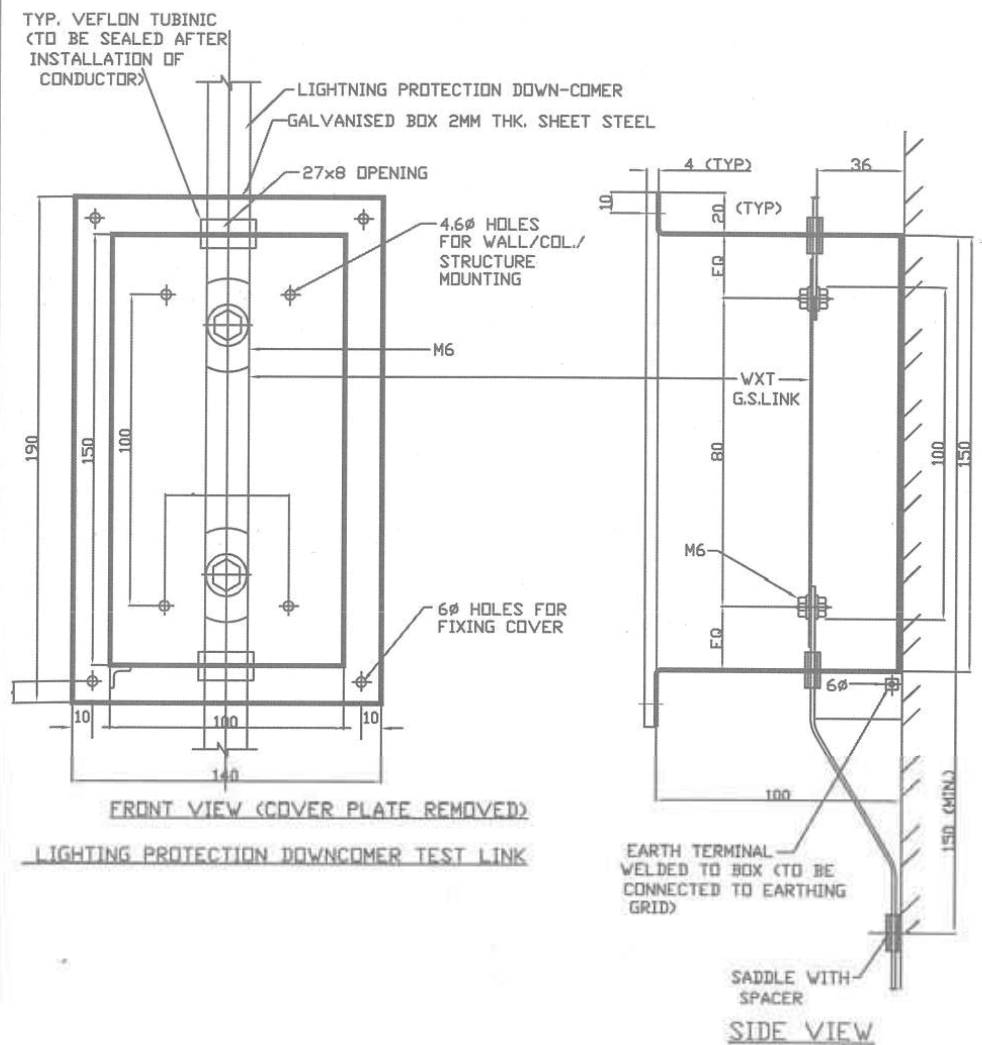
EARTHING DETAILS TRANSFORMER

NOTE.

1. ALL DIMENSIONS ARE IN mm.
2. THE TRANSFORMER RESISTOR FOR HT TRANSFORMER SHALL BE CARRIED THROUGH FLATS AS SHOWN (SUPPLIED BY TRANSFORMER SUPPLIER).

RC	FOR TENDER PURPOSE	1/2	1/3	1/4	-	VV	-	-	-	-	AS	05-02-16
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	-	AS	05-02-16
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	-	05-02-16
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHECK	M	E	C	C&I	ARCH	APPRO	DATE	
Cleared By												
 NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION												
PROJECT STANDARD												
TITLE EARTHING DETAILS												
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-045								REV. NO. RC		

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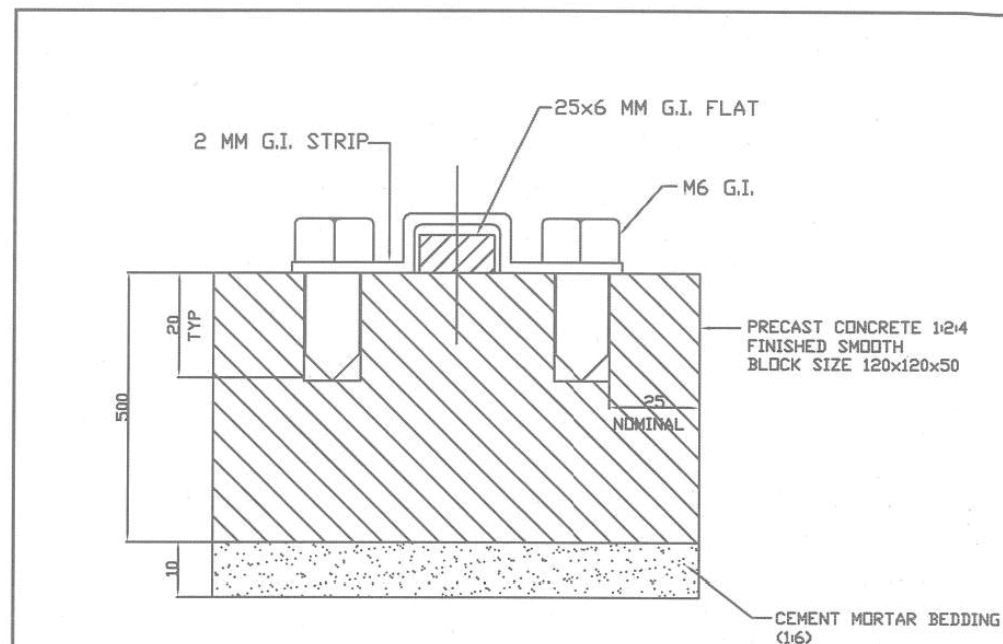


NOTE.

1. ALL DIMENSIONS ARE IN MM.
2. THE TEST LINK SHALL BE OF 2MM THK. SHEET STEEL GALVANISED AS PER REQUIREMENT OF THE WORK ORDER AND FINISH TO BE OF GIL.
3. THE DOWN COMER ENTRY AND EXIT POINTS IN TO BOX BE MADE WATER-TIGHT AFTER LAYING OF CONDUCTOR.

RC	FOR TENDER PURPOSE	1/2	1/3	2/4	-	44	-	-	-	-	-	10/05/16
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	-	-	AS
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	-	STANDARD
REV. NO.	DESCRIPTION	DESIGN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE	
 NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION												
PROJECT STANDARD												
TITLE LIGHTNING PROTECTION DETAILS.												
SIZE	SCALE	DRG. NO.		0000-211-POE-A-047					REV. NO.		RC	
A4	NTS											

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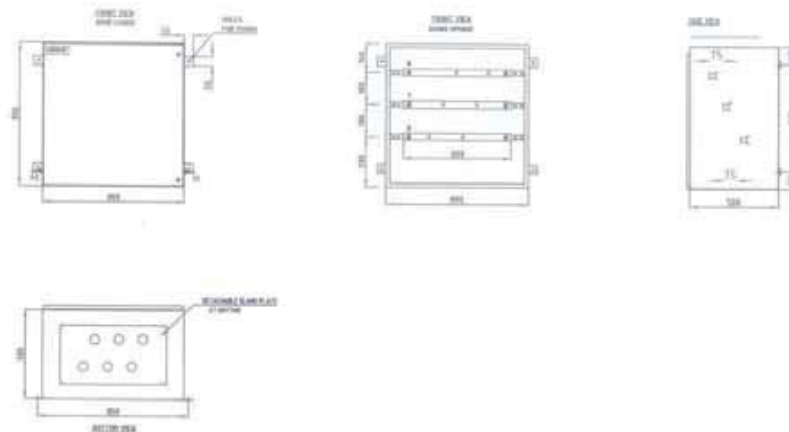
BLOCK SPACING 1000MM CENTRE TO CENTRE

TYPICAL DETAILS OF CLEATING HORIZONTAL
CONDUCTOR OVER WATER PROOFING

NOTE:
1. ALL DIMENSIONS ARE IN mm.

RC	FOR TENDER PURPOSE	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20
RB	FOR TENDER PURPOSE	RKG	RKV	RKM	RKS	RKT	RKU	RKV	RKM	RKS	RKT	RKU	RKV	RKM	RKS	RKT	RKU	RKV	RKM	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
REV. NO.	DESCRIPTION	DESIGNED	CHECKED	APPROVED	M	E	C	C&I	ARCH	APPRO	DATE									
		Cleared by																		
		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION																		
PROJECT		STANDARD																		
TITLE		LIGHTNING PROTECTION DETAILS																		
SIZE	SCALE	DRG. NO.	0000-211-POE-A-048										REV. NO.	RC						
A4	NTS																			

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GENERAL TECHNICAL PARTICULARS

1. ALL DIMENSIONS ARE IN MM.
2. TYPE: WALL/COLUMN/PEDESTAL MOUNTING TYPE.
3. SHEET: CRCA SHEET min. 2mm THK.
4. GLAND PLATE SHOULD BE OF 3MM THK ALUMINIUM, REMOVABLE TYPE WITH KNOCKOUT.
HOLE FOR I/C CABLE-1Cx300SQ.MM AL-6NOS.
HOLE FOR O/G CABLE-1Cx185SQ.MM AL-6NOS.
5. PAINT: PRETREATMENT POWDER COATING
6. SHADE: GREY RAL-9002
7. CABLE ENTRY: BOTTOM
8. BUSBAR: ELECTROLYTIC GRADE TINNED CU, OF Min: 40x10MM
9. IP-55
10. BUS BAR INSULATOR-SMC TYPE
11. BUS BAR ARRANGEMENT: HORIZONTAL
12. BUS BAR SHALL HAVE ONE HOLE DRILLED FOR CABLE CONNECTION OF EACH SIZE MENTIONED AT SLNO 4 AND SUPPLIED WITH CORRESPONDING SIZE HIGH TENSILE STRENGTH ZINC COATED STEEL BOLTS.

RA	FOR TENDER PURPOSE ONLY		REV		NO		M		E		C		C&I		ARCH		APPRO		DATE	
NO.	DESCRIPTION		DESIGNER		CHKD		M		E		C		C&I		ARCH		APPRO		DATE	
			NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION																	
PROJECT			STANDARD																	
TITLE			ADAPTOR BOX FOR LT CABLES																	
SIZE	SCALE	DRG NO.	0006-211-P05-A-048A														REV.	NO.		
A1	NTS																05			

GROUND LEVEL

EARTH BACK FILLED AND RAMMED

BRICKS

RIDDLE SOIL

CABLE

ROUTE MARKER

DETAIL - 'A'

6 DIA. HOLES FOR 4 NOS. FIXING

CAST IRON PLATE

LIGHTING CABLE

NTPC

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ROUTE MARKERS SHALL BE CONSTRUCTED OF CONCRETE WITH CAST IRON PLATE, WITH THE ROUTE INFORMATION ENGRAVED ON IT, BOLTED ON TOP OF THE CONCRETE BLOCK AS SHOWN.
3. CAST IRON PLATE SHALL BE OF Min. 6.0mm THICKNESS.

[illegible]

SUB-SECTION-II-E7

HT CABLES

**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			
HT CABLES				
1.00.00	CODES & STANDARDS			
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes : IS:7098 (Part - II) Specification for Cross linked polyethylene insulated PVC sheathed cables. Part-II: For working voltages from 3.3 KV upto and including 33 KV. IS : 3975 Low Carbon Galvanized steel wires, formed wires and tapes for armouring of cables. IS : 4905 Methods for random sampling. IS : 5831 PVC insulation and sheath of electrical cables. IS : 8130 Conductors for insulated electrical cables and flexible cords. IS : 10418 Specification for drums for electric cables. IS : 10810 Methods of tests for cables. ASTM-D -2843 Standard test method for density of smoke from the burning or decomposition of plastics. IEC-754 (Part-I) Tests on gases evolved during combustion of electric cables. IEC-332 Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).			
2.00.00	TECHNICAL REQUIREMENTS			
2.01.00	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground (buried) installation with chances of flooding by water.			
2.02.00	Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.			
2.03.00	Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.			
2.04.00	XLPE insulation shall be suitable for continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C.			
NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-	SUB SECTION-II-E7 HT CABLES	PAGE 1 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS																	
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.																	
2.06.00	For single core armoured cables, armouring shall be of aluminium wires. For multicore armoured cables armouring shall be of galvanised steel as follows : - <table><tr><td>Calculated nominal dia of cable under armour</td><td>Size and Type of armour</td></tr><tr><td>i) Upto 13 mm</td><td>1.4mm dia GS wire</td></tr><tr><td>ii) Above 13 & upto 25mm</td><td>0.8 mm thick GS formed wire/ 1.6 mm dia GS wire</td></tr><tr><td>iii) Above 25 & upto 40 mm</td><td>0.8 mm thick GS formed wire/ 2.0 mm dia GS wire</td></tr><tr><td>iv) Above 40 & upto 55mm</td><td>1.4 mm thick GS formed wire/ 2.5 mm dia GS wire</td></tr><tr><td>v) Above 55 & upto 70mm</td><td>1.4 mm thick GS formed wire/ 3.15mm dia GS wire</td></tr><tr><td>vi) Above 70mm</td><td>1.4 mm thick GS formed wire/ 4.0 mm dia GS wire</td></tr></table>				Calculated nominal dia of cable under armour	Size and Type of armour	i) Upto 13 mm	1.4mm dia GS wire	ii) Above 13 & upto 25mm	0.8 mm thick GS formed wire/ 1.6 mm dia GS wire	iii) Above 25 & upto 40 mm	0.8 mm thick GS formed wire/ 2.0 mm dia GS wire	iv) Above 40 & upto 55mm	1.4 mm thick GS formed wire/ 2.5 mm dia GS wire	v) Above 55 & upto 70mm	1.4 mm thick GS formed wire/ 3.15mm dia GS wire	vi) Above 70mm	1.4 mm thick GS formed wire/ 4.0 mm dia GS wire
Calculated nominal dia of cable under armour	Size and Type of armour																	
i) Upto 13 mm	1.4mm dia GS wire																	
ii) Above 13 & upto 25mm	0.8 mm thick GS formed wire/ 1.6 mm dia GS wire																	
iii) Above 25 & upto 40 mm	0.8 mm thick GS formed wire/ 2.0 mm dia GS wire																	
iv) Above 40 & upto 55mm	1.4 mm thick GS formed wire/ 2.5 mm dia GS wire																	
v) Above 55 & upto 70mm	1.4 mm thick GS formed wire/ 3.15mm dia GS wire																	
vi) Above 70mm	1.4 mm thick GS formed wire/ 4.0 mm dia GS wire																	
2.06.01	The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm-sq.mm/mtr at 20 deg.C. The types and sizes of aluminium armouring shall be same as mentioned for galvanised steel at 2.06.00 above.																	
2.06.02	The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wires / formed wires. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of GS wires/formed wires.																	
2.07.00	Distinct extruded PVC inner sheath of black colour as per IS:5831 shall be provided for the cables as follows: a) For all multicore cables. b) For single core armoured cables, where armouring is not being used as metallic screen.																	
2.08.00	Outer sheath shall be of PVC black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a.) Oxygen index of min. 29 (Test method as per IS 10810 Part-58) (b.) Acid gas emission of max. 20% as per IEC-754 (Part-I)																	
NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-	SUB SECTION-II-E7 HT CABLES	PAGE 2 OF 6														

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
2.09.00	(c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM D-2843.		
2.10.00	Cores of three core cables shall be identified by colouring of insulation or by providing coloured tapes helically over the cores, with Red, Yellow & Blue colours.		
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath : (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Screen Fault current _ _ _ KA for _ _ _ Sec. (Value of current & time shall be indicated as per BOQ) (d.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible.		
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.		
2.12.00	Allowable tolerances on the overall diameter of the cables shall be ±2 mm maximum over the declared value in the technical data sheets.		
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.		
2.14.00	The cross-sectional area of the metallic screen strip/tape/wires shall be considered in sizing calculations.		
2.15.00	The eccentricity shall be calculated as $\frac{t_{\max} - t_{\min}}{t_{\max}} \times 100$ and the ovality shall be calculated as $\frac{d_{\max} - d_{\min}}{d_{\max}} \times 100$		
NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-	SUB SECTION-II-E7 HT CABLES
			PAGE 3 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Where t-max/t-min is the maximum/minimum thickness of insulation and d-max/d-min is the maximum / minimum diameter of the core. The eccentricity of the core shall not exceed 10% and ovality not to exceed 2%.		
2.16.00	Cable selection & sizing		
2.16.01	HT cables shall be sized based on the following considerations: a) Rated current of the equipment b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage c) Short circuit withstand capability		
2.16.02	Derating Factors Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes: a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables.		
2.16.03	Cable lengths shall be considered in such a way that straight through cable joints is avoided.		
2.16.04	Cables shall be armoured type if laid in CHP area or directly buried		
3.00.00	CONSTRUCTIONAL FEATURES		
3.01.00	19/33 KV Grade Power Cables: Cables shall conform to IS 7098 Part-II. These cables shall be multi-stranded, compacted circular aluminium conductor, XLPE-insulated, metallic screened suitable for carrying the system earth fault current as specified in B.O.Q, PVC outer sheathed. The conductor screen and insulation screen shall both be of extruded semiconducting compound and shall be applied along with the XLPE insulation in a single operation of triple extrusion process so as to obtain continuously smooth		
NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-	SUB SECTION-II-E7 HT CABLES
			PAGE 4 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS									
4.01.03	The standard length for HT power cables shall be 1000 meter for all single core cables and 750 meters for 3 core cables. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drum with shorter lengths. One drum length of each cable size can be of non standard length (not less than 250 meter) so as to match the ordered quantity. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/-2% and the payment shall be made based on the actual cable length supplied within this limit.									
5.00.00	TESTS									
5.01.00	TYPE, ROUTINE AND ACCEPTANCE TESTS									
	1. All equipments to be supplied shall be of type tested design. During detailed engineering, 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 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. 2. However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client /Employers representative and submit the reports for approval. 3. 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. 4. 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.									
5.01.01	The following type tests reports to be submitted for one size each of 19/33 kV, 11/11kV, 6.6/6.6kV and 3.3/3.3kV cables. Size shall be decided by the employer during detailed engineering.									
	<table><tr><th>S. No</th><th>Type Test</th><th>Remarks</th></tr><tr><td></td><td>Conductor</td><td></td></tr></table>				S. No	Type Test	Remarks		Conductor	
S. No	Type Test	Remarks								
	Conductor									
NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-	SUB SECTION-II-E7 HT CABLES	PAGE 6 OF 6						

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
5.02.00	S. No	Type Test	Remarks
	1.	Resistance test	
		For Armour Wires / Formed Wires	
	2.	Measurement of Dimensions	
	3.	Tensile Test	
	4.	Elongation test	
	5.	Torsion test	For round wires only
	6.	Wrapping test	
	7.	Resistance test	
	8(a)	Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.
	8(b)	Adhesion test	For GS wires/formed wires only
		For XLPE insulation & PVC Sheath	
	9.	Test for thickness	
	10.	Tensile strength and elongation test before ageing and after ageing	
	11.	Ageing in air oven	
	12.	Loss of mass test	For PVC outer sheath only.
	13.	Hot deformation test	For PVC outer sheath only.
	14.	Heat shock test	For PVC outer sheath only
	15.	Shrinkage test	
	16.	Thermal stability test	For PVC outer sheath only
	17.	Hot set test	For XLPE insulation only
	18.	Water absorption test	For XLPE insulation only
	19.	Oxygen index test	For PVC outer sheath only
	20.	Smoke density test	For PVC outer sheath only
	21.	Acid gas generation test	For PVC outer sheath only
	22.	Flammability test as per IEC-332 Part-3 (Category -B)	For completed cable only
	23.	Insulation resistance test	Volume Resistivity method
	24.	High voltage test	
	25.*	Partial discharge test	
	26.*	Bending test	
27.*	Dielectric power factor test		
	a) As a function of voltage		
	b) As a function of temperature		
28.*	Heating cycle test		
29.*	Impulse withstand test		
	* Not applicable for 3.3/3.3kV grade cables.		
	Indicative list of tests/ checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of H.T. Cables enclosed with this chapter.		

NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-	SUB SECTION-II-E7 HT CABLES	PAGE 7 OF 6
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SUB-SECTION-II-E8

**ELECTRIC ACTUATORS WITH INTEGRAL
STARTERS**

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		
1.00.00	CODES AND STANDARDS:			
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of conflict between this specification and codes, standards, etc, the former shall prevail.			
2.00.00	ELECTRIC ACTUATORS WITH INTEGRAL STARTERS			
2.01.00	TYPE:			
2.01.01	The actuators shall have integral starters along with over load relays with built in SPP (Single Phasing Preventer). Alternatively Smart non-intrusive actuators are also acceptable. A 415, 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	In case supplier's standard control voltage for Open/Close contactors is 110V AC, the same is acceptable if suitable Opto Isolation circuit is provided with coupling relays for 24 V DC command inputs.			
2.02.00	INTERFACES:			
2.02.01	Open/Close command termination logic with position & torque Limit Switches, positioner circuit shall be suitably built in the PCB inside the actuator. (a) For Binary Drive (both ON-OFF and INCHING type) :- Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided. Interface with the control system shall be through hardware signal only. Inter posing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system. (b) For Modulating Drive:- The command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided. Also these actuators shall be Continuous modulating type. (c) Open/close command termination logic shall be suitably built inside actuator.			
2.03.00	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 isolating service:- Three successive open-close operations or 15 mins, whichever is higher. For regulating service 3000 starts per hour or required cycles, whichever is higher.			
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-II-E8 ELECTRIC ACTUATORS WITH INTEGRAL STARTERS	PAGE 1 OF 5

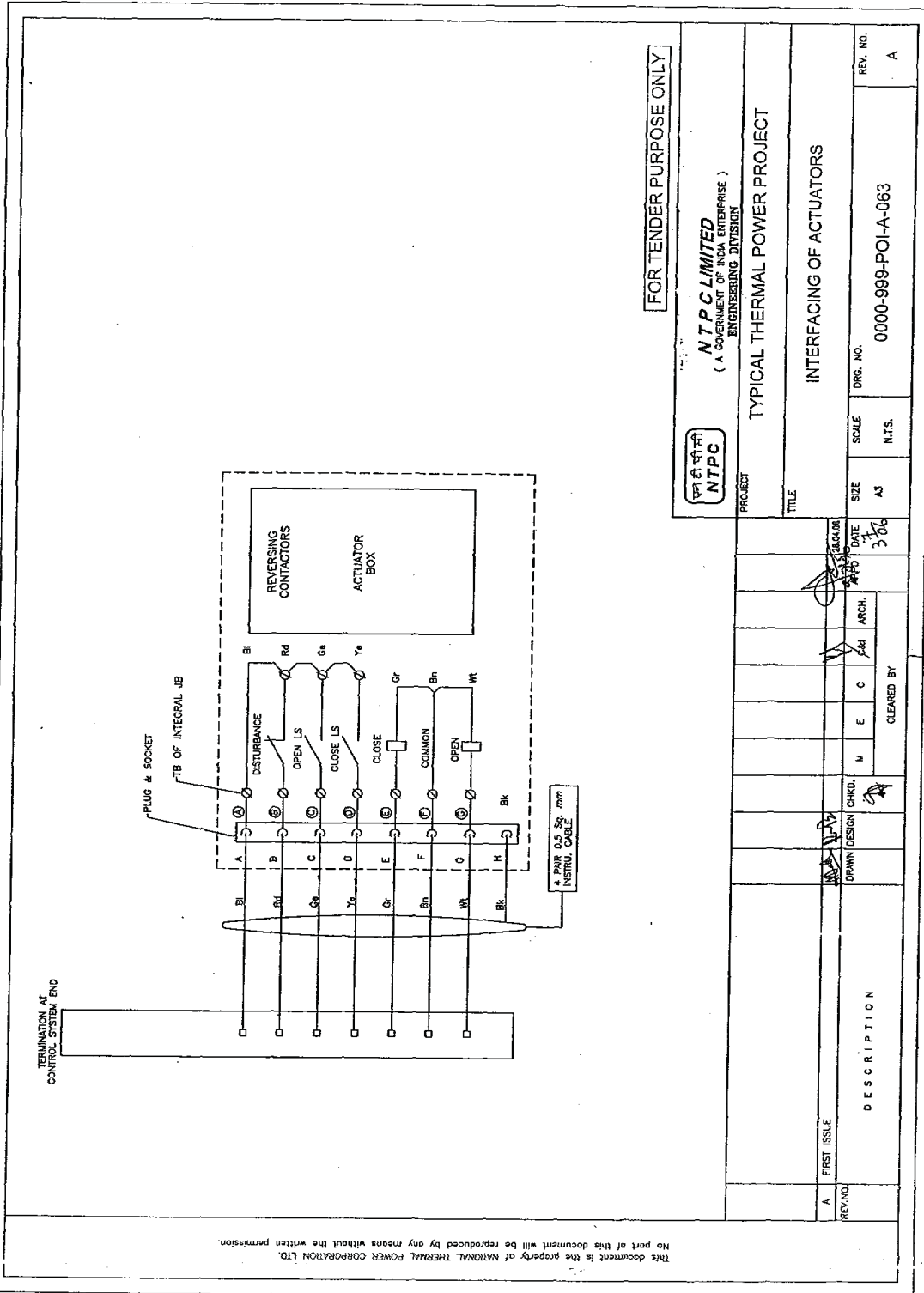
CLAUSE NO.	TECHNICAL REQUIREMENTS	एन टी पी सी NTPC		
2.04.00 CONSTRUCTION: (a) Enclosure: Totally enclosed weatherproof minimum IP-55 degree of protection. (b) Gear Train : Metal (Fibre gears are not acceptable)) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energized. (c) Manual Wheel: Shall disengage automatically during motor operation. 2.05.00 MOTOR : (a) Type : Squirrel cage induction motor suitable for Direct On Line (DOL)starting. (b) Enclosure: Totally enclosed, self ventilated IP-55 degree of protection. (c) Insulation Class B or better. 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 Contractor's design Suitable means shall be provided to diagnose the type of fault locally. 2.06.00 POSITION/TORQUE SWITCHES: 2.06.01 Four nos. (2 each in open and close position) position limit switches/contacts and two nos. (one in open and other in close direction) torque switches/contacts each having two nos. NO and two nos. NC contacts shall be provided. Torque switches/contacts shall be bypassed in both the end positions with the other end Limit switches/contacts.				
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-II-E8 ELECTRIC ACTUATORS WITH INTEGRAL STARTERS	PAGE 2 OF 5	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Limit switches/contacts Limit switches shall be Silver plated with high conductivity and non –corrosive type. Contact rating shall be sufficient to meet the requirement of Control System subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP-55. Limit switch/contacts and disturbance signals shall be available to DCS even when the power supply to the actuators is not available. 2.07.00 LOCAL OPERATION: 2.07.01 It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator. 2.08.00 POSITION INDICATOR : 2.08.01 To be provided for 0 to 100% travel. 2.09.00 POSITION TRANSMITTER (FOR MODULATING/INCHING TYPE) : 2.09.01 As required. Suitable for stabilized 4-20 mA signal, 2 wire inductive type, External 24 volts DC operated. 2.10.00 WIRING : 2.10.01 Suitable voltage grade copper wire. 2.11.00 TERMINAL BOX : (i) 9 pin plug and socket (1 no. per actuator to suit 4 pair 0.5 sq.mm. copper overall shielded (16 mm OD), instrumentation cable) suitably mounted in the starter box itself to terminate open/close command and status feedback signals with external control systems. (ii) Additional one number 9 pin plug and socket (to suit 4 pair 0.5 sq.mm copper (16 mm OD) individual and overall shielded instrumentation cable) suitably mounted in the starter box itself for actuators with 4-20 mA position transmitters. (iii) Necessary glands for power cables shall be provided. 2.12.00 TERMINAL BLOCK : 2.12.01 650V grade. For power cables. 2.13.00 SPACE HEATER : 2.13.01 Space heater of suitable rating. The supply shall be derived from the main power supply available in the actuator.			
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-II-E8 ELECTRIC ACTUATORS WITH INTEGRAL STARTERS	PAGE 3 OF 5	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.14.00 2.14.01 3.00.00	TYPICAL WIRING DIAGRAM : Refer Tender Drawing No. 0000-999-POI-A-063. TRAINING Contractor shall provide training on Integral Actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.			
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-II-E8 ELECTRIC ACTUATORS WITH INTEGRAL STARTERS	PAGE 4 OF 5	

CLAUSE NO.

TECHNICAL REQUIREMENTS



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-II-E8
ELECTRIC ACTUATORS
WITH INTEGRAL STARTERS

PAGE
5 OF 5

SUB-SECTION-II-E9

HT SWTIGCHGEAR

**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														
1.00.00	DESIGN CRITERIA FOR MV SWITCHGEARS														
	Sizing Criteria														
	The Sizing criteria for MV Switchgears shall be the short time fault withstand levels, impulse withstand levels, Continuous Current rating for the MV Switchboards and Modules.														
	Sizing For fault Conditions														
	Fault Level shall be the basic selection Criteria for MV switchgears. Typical Fault ratings are as detailed under Technical parameters (B-0).														
	Sizing For Load Current Duty														
	a) The sizing Criteria for a Typical MV Switchboard shall be determined by the size of the transformer feeding the board. As a design Philosophy the Board continuous Current shall be selected as (1.1) * (Full load current at rated voltage on the Transformer's secondary) at 50 deg. C Ambient.														
	b) 3.3KV supply System shall be designed for supplying power to MV drives at 3.3 KV level. Each of the switchgear shall have two incomers and bus sections. Each bus section and transformer is rated for 100 % capacity, so that incoming cable fault etc. does not necessitate complete outage of entire switchgear. Interconnection between transformer and 3.3 KV Switchgear shall be by bus ducts.														
	Design of Outgoing feeders:														
	The various outgoing feeders shall be Feeders for Motors, Auxiliary Transformers, Tie feeders and Supply feeders. While sizing the outgoing feeder the rating is calculated based on the following:														
Motor Feeder:	KW Rating/ [System Vol * 1.732 * (Eff) *(Pf)] *1.1 (at least)														
Transformer feeder:	Transformer KVA/ primary [Voltage * 1.732] *1.1 (at least)														
Tie feeder:	As per system requirement														
Incomer feeders:	Generally same as the Board rating														
Bus Couplers:	Generally 2/3 of the Incomer Feeder rating.														
Standard MV Switchgear Modules and their Selection Criteria															
MV feeders shall be categorized into standard Modules. The module defines the feeder type, Protections, Feeder schematics and metering and monitoring requirements. The Standard Modules are listed in table below:															
<table><tr><th>S No</th><th>Module Type</th><th>Application</th><th>Applicability</th></tr><tr><td>1</td><td>DA</td><td>Motor Feeder</td><td>MV Motor Feeders < 2 MW</td></tr><tr><td>2</td><td>DAF</td><td>Motor Feeder with Differential</td><td>MV Motor Feeders > 2 MW</td></tr></table>				S No	Module Type	Application	Applicability	1	DA	Motor Feeder	MV Motor Feeders < 2 MW	2	DAF	Motor Feeder with Differential	MV Motor Feeders > 2 MW
S No	Module Type	Application	Applicability												
1	DA	Motor Feeder	MV Motor Feeders < 2 MW												
2	DAF	Motor Feeder with Differential	MV Motor Feeders > 2 MW												
LOT-1A PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR	Page 1 of 39											

CLAUSE NO.	TECHNICAL REQUIREMENTS					
			Protections			
	3	DB	Transformer Feeder	Transformer feeder < 5 MVA		
	4	DBF	Transformer Feeder with Differential Protections	Transformer feeder > 5 MVA		
	5	DC	Incomer Feeder	MV Incomer Module		
	6	DD	Bus Coupler Feeder	Bus Coupler Module for MV Boards		
	7	DE	Tie Feeder	Tie Between boards		
	Spare capacity and Future Requirements					
	all MV Switchboards is provided with one spare motor feeder and one transformer feeder on each section for future requirements. Plant control cable Interconnections					
	a) Standard control cable sizes shall preferably be 3CX1.5, 5CX1.5, 7CX1.5 & 10CX1.5 mm ²					
	b) Cable size for motor space heater application shall be 2CX2.5 mm ²					
c) Interconnections for Current Transformer terminals shall use two cores of 1.5mm ² size per phase						
d) Core identification shall be using core color for up to 5-core cable and core number for cable with more cores						
e) Separate control cables shall be used for current transformers.						
f) - Separate control cables shall be laid for EPB (Emergency/Local Push Button) status from EPB to Switchgear for the Switchgear and DCS.						
2.00.00	CODES AND STANDARDS					
All standards, specification and codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS Codes, Standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards and codes						
a)		IS: 722	AC electricity meters.			
b)		IS: 996	Single phase small AC and universal electrical motors.			
c)		IS: 1248	Direct Acting indicating analogue electrical measuring instruments and Accessories.			
d)		IS/IEC: 60947	Degree of protection provided by enclosures for low voltage switchgear and control gear.			
e)		IS: 2544	Porcelain post insulators for systems with nominal voltages greater than 1000 Volts.			
f)		IS: 2705	Current transformers.			
g)		IS: 3156	Voltage Transformers			
h)		IS: 6005	Code of practice for phosphating of iron and steel.			
i)		IS: 3427	Metal enclosed switchgear and control gear			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR		Page 2 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS																			
	j)	IS: 5082	Specification for wrought aluminum and aluminum alloy bars, rods, tubes and selections for electrical purposes.																	
	k)	IEC: 61850	Communication Standard for Numerical relays																	
	l)	IEC: 61131-3	Automation Standard for Numerical relays																	
	m)	IS: 9046	AC contactors for voltages above 1000 volts and upto and including 11000 Volts.																	
	n)	IS: 13703	Low voltage fuses																	
	o)	IS: 9385	HV fuses																	
	p)	IS: 9431	Specification for indoor post insulators of organic material for system with nominal voltages greater than 1000 volts upto and including 300 kV																	
	q)	IS: 9921	A.C. disconnectors (isolators) and Earthing switches for voltages above 1000 V																	
	r)	IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.																	
	s)	IS: 13118	Specification for high voltage AC circuit breakers.																	
	t)	IEC: 60099-4	Metal oxide surge arrestor without gap for AC system																	
	u)	IEC: 62271-100	High voltage alternating current circuit breakers.																	
	v)	IS/IEC: 62271-200	High voltage metal enclosed switchgear and control gear.																	
	w)	IEC: 60947-7-1	Terminal blocks for copper conductors																	
	(x)	IS :513 (2008)	Cold Rolled Low Carbon Steel Sheets and Strips																	
	2.1.00	Installation shall conform to Indian Electricity Act and Indian Electricity Rules as amended upto date. The Indian Electricity Act and Indian Electricity Rules can be obtained from : Kitab Mahal State Emporium Building, Baba Kharag Singh Marg, New Delhi - 110 001 INDIA.																		
2.2.00	Equipment conforming to any other internationally accepted standards will also be considered if they ensure performance and constructional features equivalent or superior to the standards listed above. In such case, the contractor shall clearly indicate the standard(s) adopted. The contractor shall furnish copy in English of the latest revision of the standards along with the copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.																			
3.00.00	TECHNICAL PARAMETERS																			
<table><tr><td colspan="4">a) SYSTEM PARAMETERS</td></tr><tr><td>1</td><td>Nominal System voltage</td><td>11 kV</td><td>3.3 kV</td></tr><tr><td>2</td><td>Highest System voltage</td><td>12 kV</td><td>3.6 kV</td></tr><tr><td>3</td><td>Rated Frequency</td><td>50 Hz</td><td>50 Hz</td></tr></table>					a) SYSTEM PARAMETERS				1	Nominal System voltage	11 kV	3.3 kV	2	Highest System voltage	12 kV	3.6 kV	3	Rated Frequency	50 Hz	50 Hz
a) SYSTEM PARAMETERS																				
1	Nominal System voltage	11 kV	3.3 kV																	
2	Highest System voltage	12 kV	3.6 kV																	
3	Rated Frequency	50 Hz	50 Hz																	
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR																
				Page 3 of 39																

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC	
	4	Number of phases/ poles	Three	Three		
	5	System neutral earthing	Earthed through Resistance to limit fault current to			
			600A	600A		
	6	One minute power frequency withstand voltage				
		- for Type tests	28	10		
		- for Routine tests	28	10		
	7	1.2/50 microsecond Impulse withstand voltage	75 kV (peak)	40 kV(peak)		
	8	Maximum system fault level including initial motor contribution	40 kA (rms)	40 kA (rms)		
	9	Short time rating for bus bars, ckt. breakers, current transformers and swgr. Assembly.	40 kA (rms) for one (1) sec.	40 kA (rms) for one (1) sec.		
	10	Dynamic withstand rating	100 kA (peak)	100 kA (peak)		
	11	IAC Rating	40 KA,1 sec			
	11	Control supply voltage				
		- Trip and closing coils	240V DC	240V DC		
		- Spring charging motor	240V DC	240V DC		
		- Space heaters	240 V AC single phase with neutral solidly earthed			
	12	Maximum ambient air temperature	50 deg. C	50 deg. C		
	b) BUS BARS					
	1.	Continuous current 0 rating at 50 C ambient:	As Per System requirements and preferably the current ratings shall be 2700 amp, 2500 Amp, 2000Amp, 1600 Amp and 1000 Amp.			
	2.	Temper Rise allowed above ambient	40 ⁰ C for plain joints 55 ⁰ C for Silver plated joints			
	c) SWGR. CUBICLE CONSTRUCTIONAL REQUIREMENTS					
	1.	Color finish				
	LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR	
				Page 4 of 39		

CLAUSE NO.	TECHNICAL REQUIREMENTS					
	Exterior	RAL9002 (Main body) RAL 5012 (Extreme end covers)				
2.	Cable entry					
	a)	Power Cables	Bottom			
	b)	Control Cables	Bottom			
3.	Bus duct entry	Top				
4.	Earthing conductor	Galvanized steel strip				
5	Service Continuity of swgrs(as per IS/IEC 62271-200)	LSC2B-PM				
d) CIRCUIT BREAKERS						
1.	The circuit breakers current rating shall be selected from the load current given in SLD which is at an ambient of 50 ^o C.					
2.	Short circuit breaker Current	11 kV	3.3 kV			
	a) A.C. component	40kA	40 kA			
	b) D.C. component	As per IS: 13118 or IEC-62271				
3.	Short Circuit making current	100 kA (peak)	100 kA (peak)			
4.	Operating Duty	B-3 Min-MB-3 Min-MB				
5.	Total break time	Not more than 4 cycles				
6.	Total make time	Not more than 5 cycles				
7.	Operating Mechanism	Motor wound spring charged stored energy type as per IEC-62271				
e) CURRENT TRANSFORMER						
1.	Class of Insulation	Class E or better				
2.	Rated output of each	Adequate for the relays and devices connected, but not less than five (5) VA.				
3.	Accuracy class					
	Protection & Measurement	Class PS for differential & REF and core balance CTs; 5P20 for other protection CTs. Required Accuracy for metering is 0.2s for feeders as marked in SLD				
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR Page 5 of 39		

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	4.	Minimum primary earth fault current to be detected by core balance current Transformer	3 Amperes	
	f) VOLTAGE TRANSFORMERS			
	1.	Rated Voltage Factor	1.2 continuous for all VTs, and 1.9 for 8 hours for star connected VTs.	
	2.	Class of insulation	Class E or better	
	3.	Other parameters	BUS PT-0.5 Class,VA req. adequate for application. Line PT-0.5 Class for sync./3P for door interlocks, VA req. adequate for application. 0.2 class PT for defined feeders as per SLD for metering application, VA req. adequate for application.	
	g) H.V. FUSES			
	1.	Voltage class	3.3KV	
	2.	Rupturing Capacity	Adequate for 100 kA (peak)	
	3.	Rated current	As per application	
	h) SURGE ARRESTERS (FOR MOTOR FEEDERS)			
			11 kV	3.3KV
	1.	Nominal discharge Current (8x20 μs)	5kA	5kA
	2.	Max. system voltage (rms)	12 kV	3.6KV
	3.	Rated Voltage of Surge arrestor	12 KV	4.5 KV
	4.	Max allowable Residual voltage at nominal discharge current	40 kV	15KV
	5.	Mounting	Inside panel	Inside panel
	i) CONTACTORS :			
	1.	Nominal System Voltage	3.3KV	
	2.	Highest System Voltage	3.6KV	
	3.	Rated Frequency	50 HZ	
	LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
4.00.00 4.1.00	4.	Rated Continuous Current at 50°C ambient	Current rating shall be selected appropriate for the load current	
	5.	Control Supply Voltage	240V DC unearthed	
	6.	Utilisation category	AC-3	
	GENERAL TECHNICAL REQUIREMENTS			
	Switchgear Panel (a) The switchgear boards shall have a single front, single tier, fully compartmentalized, metal enclosed construction complying with clause No. 3.102 of IEC 62271-200, comprising of a row of free standing floor mounted panels. Each circuit shall have a separate vertical panel with distinct compartments for circuit breaker / contactor truck, cable termination, main busbars and auxiliary control devices. The adjacent panels shall be completely separated by steel/aluzinc sheets except in busbar compartments where insulated barriers shall be provided to segregate adjacent panels. The Service Class Continuity of Switchgears shall be LSC 2B-PM (as per IS/ IEC 62271-200). However, manufacturer's standard switchgear designs without inter panel barriers in busbar compartment may also be considered. (b) The circuit breakers / contactors and bus VTs shall be mounted on withdraw able trucks which shall roll out horizontally from service position to isolated position. For complete withdrawal from the panel, the truck shall rollout on the floor or shall roll out on telescopic rails. In case the later arrangement is offered, suitable trolley shall be provided by the Contractor for withdrawal and insertion of the truck from and into the panel. The number of trolleys to be provided shall be as specified. Testing of the breaker / contactor shall be possible in Isolated position by keeping the control plug connected. (c) The trucks shall have distinct SERVICE and ISOLATED positions. It shall be possible to close the breaker / contactor compartment door in isolated position also, so that the switchgear retains its specified degree of protection. Circuit Breaker rack-in and rack-out from Service to Test, Test to Isolated position, or vice-versa shall be possible only in the compartment door closed condition. While switchboard designs with doors for breaker / contactor compartments would be preferred, standard designs of reputed switchgear manufacturers where the truck front serves as the compartment cover may also be considered provided the breaker / contactor compartment is completely sealed from all other compartments and retains the IP-4X degree of protection in the Isolated position. In case the latter arrangement is offered, the Contractor shall explain how this sealing is achieved and shall include blanking covers one for each size of panel per switchboard.. (d) The switchgear assembly shall be dust, moisture, rodent and vermin proof, with the truck in any position SERVICE, ISOLATED or removed, and all doors and covers closed. All doors, removable covers and glass windows shall have gaskets all round with synthetic rubber or neoprene gaskets. (e) The VT/ relay compartments shall have degree of protection not less than IP 5X in accordance with IS/IEC 60947. However, remaining compartments can have a degree of protection of IP 4X. All louvers, if provided, shall have very fine brass or GI mesh screen. Tight fitting gourmet / gaskets are to be provided at all openings in relay compartment. Numerical Relays shall be fully Flush mounted on the switchgear panels at a suitable height.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR Page 7 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	(f) The Switchgear shall have an Internal Arc Classification of IAC FLR 40KA, 1 sec. The switchgear construction shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panels shall be specially designed to withstand these. Pressure relief device shall be provided in each high voltage compartment of a panel, so that in case of a fault in a compartment, the gases produced are safely vented out, thereby minimizing the possibility of its spreading to other compartments and panels. The pressure relief device shall not however reduce the degree of protection of panels under normal working conditions. To demonstrate that the pressure relief device operates satisfactorily the Contractor shall submit the type test report in line with IEC 62271-200 Annex - A. Wherever louvers are provided, the construction of louvers shall be such that the IAC requirements are satisfied. Further, viewing glass windows shall have the same strength as that of enclosure against internal Arc. (g) Enclosure shall be constructed with rolled steel/aluzinc sections. The doors and covers shall be constructed from cold rolled steel sheets of 2.0 mm or higher thickness. Gland plates shall be 2.5 mm thick made out of hot rolled or cold rolled steel sheets and for non magnetic material it shall be 3.0 mm. (h) The switchgear shall be cooled by natural air flow and forced cooling is allowed only for the panels rated above 3000A. (i) Total height of the switchgear panels shall not exceed 2600 mm. The height of switches, pushbuttons and other hand operated devices shall not exceed 1800 mm and shall not be less than 700 mm. (j) Necessary guide channels shall be provided in the breaker compartments for proper alignment of plug and socket contacts when truck is being moved to SERVICE position. A crank or lever arrangement shall preferably be provided for smooth and positive movement of truck between Service and Isolated positions. (k) Safety shutters complying with IEC 62271-200 shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the truck is moved to ISOLATED position. The shutters shall move automatically, through a linkage with the movement of the truck. Preferably it shall however, be possible to open the shutters of busbar side and cable side individually against spring pressure for testing purpose after defeating the interlock with truck movement deliberately. In case, insulating shutters are provided, these shall meet the requirements of IEC 62271-200 and necessary tests as per IEC 62271-200 Clause 5.103.3.3 shall be carried out. A clearly visible warning label "Isolate elsewhere before earthing" shall be provided on the shutters of incoming and tie connections which could be energised from other end. (l) Switchgear construction shall have a bushing or other sealing arrangement between the circuit breaker / Contactor compartment and the busbar / cable compartments, so that there is no air communication around the isolating contacts in the shutter area with the truck in service position. (m) The breaker / contactor and the auxiliary compartments provided on the front side shall have strong hinged doors. Busbar and cabling compartments provided on the rear side shall have separate bolted covers with self retaining bolts for easy maintenance and safety. Breaker / Contactor compartment doors shall have locking facility and shall be provided with single shot latch type handle. Suitable interlock shall be provided, which will ensure that breaker is OFF before opening the bolted covers /back doors. For Incomer/Tie panels suitable interlock shall be provided to prevent opening of any compartment doors which has any of the MV (33kV/11kV/6.6kV/3.3kV) equipment, in case the incoming supply is ON.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR	Page 8 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
4.2.00	(n) In the Service position, the truck shall be so secured that it is not displaced by short circuit forces. Busbars, jumpers and other components of the switchgear shall also be properly supported to withstand all possible short circuit forces corresponding to the short circuit rating specified. (o) Suitable base frames made out of steel channels shall be supplied along with necessary anchor bolts and other hardware, for mounting of the switchgear panels. These shall be dispatched in advance so that they may be installed and leveled when the flooring is being done, welding of base frame to the insert plates as per approved installation drawings shall be in Contractor's scope. (p) The switchboard shall have the facility of extension on both sides. Adopter panels and dummy panels required to meet the various busbar arrangements, cable / busduct termination and layouts shall be included in Contractor's scope of work.			
	Circuit Breakers a) The circuit breakers shall be of Vacuum type. They shall comprise of three separate, identical single pole interrupting units, operated through a common shaft by a sturdy operating mechanism. b) Outgoing breakers shall be suitable for switching transformers and motors at any load. They shall be capable of being used for frequent direct-on-line starting of squirrel cage induction motors of following ratings : 1)3.3KV Above 160 kW up to 1500 kW (The contractor may adopt 415V/3.3KV for drives rated in the range of 160-210 kW) 2)6.6 kV Above 200 kW 3)11 kV Above 1500 kW Surge arrestor shall be provided for each motor feeder. c) Circuit breaker shall be restrike free, stored energy operated and trip free type. Motor wound closing spring charging shall only be acceptable. An antipumping relay shall be provided for each breaker, even if it has built-in mechanical anti-pumping features. An arrangement of two breakers in parallel to meet a specified current rating shall not be acceptable. d) During closing, main poles shall not rebound objectionably and mechanism shall not require adjustments. Necessary dampers shall be provided to withstand the impact at the end of opening stroke. Slow closing facility shall preferably be provided for checking and adjustment of arc chutes and poles when the breaker is completely withdrawn and isolated. e) Plug and socket isolating Contacts for main power circuit shall be silver plated, of self aligning type, of robust design and capable of withstanding the specified short circuit currents. They shall preferably be shrouded with an insulating material. Plug and socket contacts for auxiliary circuits shall also be silver plated, sturdy and of self aligning type having a high degree of reliability. Thickness of silver plating shall not be less than 10 microns. f) All working part of the mechanism shall be of corrosion resisting material. Bearings which require greasing shall be equipped with pressure type grease fittings. Bearing pins, bolts, nuts and other parts shall be adequately secured and locked to			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR	Page 9 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
4.3.00	prevent loosening or change in adjustment due to repeated operation of the breaker and the mechanism. g) The operating mechanism shall be such that failure of any auxiliary spring shall not prevent tripping and shall not lead to closing or tripping of circuit breaker. Failure of any auxiliary spring shall also not cause damage to the circuit breaker or endanger the operator. h) Mechanical indicators shall be provided on the breaker trucks to indicate OPEN / CLOSED conditions of the circuit breaker, and CHARGED / DISCHARGED conditions of the closing spring. An operation counter shall also be provided. These shall be visible without opening the breaker compartment door. i) The rated control supply voltage shall be as mentioned elsewhere under Technical parameters. The closing coil and spring charging motor shall operate satisfactorily at all values of control supply voltage between 187V-242V/93.5V-121 V DC. The shunt trip coil shall operate satisfactorily under all operating conditions of the circuit breaker up to its rated short circuit breaking current at all values of control supply voltage between 154-242V DC /77 V-121 V DC. The trip coil shall be so designed that it does not get energized when its healthiness is monitored by two indicating lamps (Red) and one trip coil supervision relay. j) The time taken for charging of closing spring shall not exceed 30 seconds. The spring charging shall take place automatically preferably after a closing operation. Breaker operation shall be independent of the spring charging motor which shall only charge the closing spring. Opening spring shall get charged automatically during closing operation. As long as power supply is available to the charging motor a continuous sequence of closing and opening operations shall be possible. One open-close- open operation of the circuit breaker shall be possible after failure of power supply to the motor. Spring charging motors shall be capable of starting and charging the closing spring twice in quick succession without exceeding acceptable winding temperature when the control supply voltage is any where between 187V-242V/93.5V-121 V DC. The initial temperature shall be as prevalent in the switchgear panel during full load operation with 50 deg. C ambient air temperature. The motor shall be provided with short circuit protection. k) Motor windings shall be provided with class E insulation or better. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in a hot, humid and tropical climate. l) Circuit breaker shall be provided with inter pole barriers of insulating materials. The use of inflammable materials like Hylam shall not be acceptable.			
	Contactactor (a) The Contractor shall offer only HRC fuse backed, mechanically latched type contactor for outgoing motor feeder panels (designated as module type CC) for drives with frequent start / stop. (b) The medium voltage contactors shall be of AC-3 utilization category and shall be vacuum type. The fuse and contactor assembly shall be mounted on a withdrawable truck. Circuits shall be provided with suitable single phasing protection. If required the contactor coil shall have a suitable economy resistor in series and shall be rated for satisfactory operation at 187V-242V/93.5V-121 V DC.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR	Page 10 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
4.4.00	(c) The fuse and overload relay shall be fully coordinated, so that the contactor operates only for a fault current less than its interrupting capability. The fuses shall be provided with mechanical trip indication. (d) The contactors shall close satisfactorily with a control voltage between 187V-242V/93.5V-121 V DC trip satisfactorily with a control voltage 154-242V DC /77 V-121 V DC. Mechanical indication of contactor open / closed shall be provided. An anti-pumping relay shall be provided even if it has mechanical anti-pumping feature. (e) Surge suppressors shall be provided on all contactor controlled motor feeders. Surge Arrestor The surge arrestors shall be provided for all motor feeders and shall be metal oxide, gapless type generally in accordance with IEC 60099-4 and suitable for indoor duty. These shall be mounted within the switchgear cubicle between line and earth, preferably in the cable compartment. Surge arrestor selected shall be suitable for non-effectively earthed system and rating shall be in such a way that the value of steep fronted switching over voltage generated at the switchgear terminals shall be limited to the requirements of switchgear.		
4.5.00	Control and Interlocks		
4.5.1	The circuit breaker / contactor will normally be controlled from remote control panels (DDCMIS) as well as from Switchgear SCADA System (via Numerical Relays) through closing and shunt trip coils. The Local control console of the relay flush mounted on the switchgear would normally be used only for testing of circuit breaker / contactor in isolated position. Provision for closing & tripping of the circuit breaker shall be possible locally from laptop / relay HMI through serial port shall be possible to facilitate commissioning activities.		
4.5.2	The basic control scheme shall be developed as per the schematic logics in the relay. The schematics shall be developed in soft inside the relay.		
4.5.3	Facilities shall be provided for mechanical tripping of the breaker/ contactor and for manual charging of the stored energy mechanism for a complete duty cycle, in an emergency in closed door condition.		
4.5.4	Each panel shall have two separate limit switches, one for the Service position and the other for isolated position. Each of these limit switches shall have at least four (4) contacts which shall close in the respective positions.		
4.5.5	Auxiliary Contacts of breaker / contactor may be mounted in the fixed portion or in the withdrawable truck as per the standard practice of the manufacturer, and shall be directly operated by the breaker / contactor operating mechanism.		
4.5.6	Auxiliary contacts mounted in the fixed portion shall not be operable by the operating mechanism, once the truck is withdrawn from the service position, but remain in the position corresponding to breaker / contactor open position. Auxiliary contacts mounted on the truck portion, and dedicated for DDCMIS use shall be wired out in series with a contact denoting breaker / contactor service position. With truck withdrawn, the auxiliary contacts shall be operable by hand for testing.		
4.5.7	The contacts of all limit switches and all breaker / contactor auxiliary contacts located on truck portion and fixed portion shall be silver plated, rated to make, carry and break 1.0A 240V DC (Inductive) / 10A 240V AC. Contacts of control plug and socket shall be capable of carrying the above current continuously.		
4.5.8	Movement of truck between SERVICE and ISOLATED positions shall be mechanically prevented when the breaker / contactor is closed. An attempt to withdraw a closed breaker / contactor shall not trip it.		
LOT-1A PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR Page 11 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	extend through out the length of each switch board. It shall be bolted/ welded to the framework of each panel and each breaker / contactor earthing contact bar. b) The earth bus shall have sufficient cross section to carry the momentary short-circuit and short time fault currents to earth as indicated under switchgear parameters without exceeding the allowable temperature rise. c) Suitable arrangement shall be provided at each end of the earth bus for bolting to earthing conductors. All joint splices to the earth bus shall be made through at least two bolts and taps by proper lug and bolt connection. d) All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical continuity of the whole switchgear enclosure frame work and the truck shall be maintained even after painting. e) The truck and breaker / contactor frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker / contactor frame shall be maintained in all positions i.e. SERVICE and ISOLATED as well as throughout the intermediate travel. The truck shall also get and remain earthed when the control plug is connected irrespective of its position. f) All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering shall not be acceptable. Looping of earth connections which would result in loss of earth connection to other devices, when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths of earth bus is acceptable. g) VT and CT secondary neutral point earthing shall be at one place only on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit may be removed without disturbing the earthing of other circuits. h) Separate earthing trucks shall be provided by the Contractor for maintenance work. These trucks shall be suitable for earthing the switchgear busbars as well as outgoing / incoming cables or busducts. The trucks shall have a voltage transformer and an interlock to prevent earthing of any live connection. The earthing trucks shall in addition have a visual and audible annunciation to warn the operator against earthing of live connections. As an alternative to separate earthing trucks the Contractor may also offer built-in earthing facilities for the busbars and outgoing / incoming connections, in case such facilities are available in their standard proven switchgear design. The inbuilt earthing switches shall have provision for short circuiting and earthing a circuit intended to be earthed. These switches shall be quick make type, independent of the action of the operator and shall be operable from the front of the switchgear panel. These switches shall have facility for padlocking in the earthed condition. i) Interlocks shall be provided to prevent : 1) Closing of the earthing switch if the associated circuit breaker truck is in Service position. 2) Insertion of the breaker truck to Service position if earthing switch is in closed position.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR	Page 13 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.8.00	3)	Closing of the earth switch on a live connection. Three (3) nos. voltage capacitive dividers shall be provided on each phase of the section intended for earthing and three (3) nos. "RED" neon lamps connected to these on the panel front for visual indication.		
	4)	Energizing an earthed Section.		
4.9.00	Complete details of arrangement offered shall be included in the bid, describing the safety features and interlocks.			
	j)	The earthing device (truck / switch) shall have the short circuit withstand capability equal to that of associated switchgear panel. 4 NO + 4 NC of auxiliary contacts of the earthing device shall be provided for interlocking purpose.		
	k)	All hinged doors shall be earthed through flexible earthing braid.		
	Painting			
	All sheet steel work shall be pretreated, in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "Class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, Electrostatic Powder Coating shall be used. Powder should meet requirements of IS 13871 (Powder costing specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the owner. The paint thickness shall not be less than 50 microns. Finished parts shall be suitably packed and wrapped with protective covering to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.			
	Instrument Transformers			
	a)	All single-section switchboards shall be provided with two numbers of separate bus VT panels complete with all accessories.		
	b)	All current and voltage transformers shall be completely encapsulated cast resin insulated type, suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated load and the outside ambient temperature is 50 deg. C. The class of insulation shall be E or better.		
	c)	All instrument transformers shall withstand the power frequency and impulse test voltage specified for the switchgear assembly. The current transformer shall further have the dynamic and short time ratings at least equal to those specified for the associated switchgear and shall safely withstand the thermal and mechanical stress produced by maximum fault currents specified when mounted inside the switchgear for circuit breaker modules. However, current transformer mounted in fuse backed contactor module shall have the dynamic and short time rating compatible with the let through current of the fuses.		
	d)	The parameters of instrument transformers specified in this specification are tentative and shall be finalized by the owner in due course duly considering the actual burden of various relays and other devices finally selected. In case the Contractor finds that the specified ratings are not adequate for the relays and other devices offered by him, he shall offer instrument transformer of adequate ratings and shall bring out this fact clearly in his bid.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR
Page 14 of 39				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.10.00	(e) All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block. (f) Current transformers may be multi or single core and shall be located in the cable termination compartment. All voltage transformers shall be single phase type. The bus VTs shall be housed in a separate panel on a truck so as to be fully withdrawable. (g) Core balance CTs (CBCT) shall be provided on outgoing motor and transformer feeders having CT ratio more than 50/1A. These CBCTs shall be mounted inside the switchgear panel. The window size of CBCTs shall be based on the overall diameter of the cables, to be finalised during detailed engineering. The CBCT shall be of circular window type. (h) All voltage transformers shall have suitable HRC current limiting fuses on both primary and secondary sides. Primary fuses shall be mounted on the withdrawable portion. Replacement of the primary fuses shall be possible with VT truck in ISOLATED position. The secondary fuses shall be mounted on the fixed portion and the fuse replacement shall be possible without drawing out the VT truck from Service position. All voltage transformers shall be designed and manufactured for 0.8 Tesla operating point on B-H curve. VT shall be fully insulated type (i.e. double pole construction and neutral side fully insulated to rated BIL). VT shall be manufactured without any joint in secondary winding.			
	Control Supply and Space Heater Supply (a) All switchboards shall be provided with separate LV panels at both the extreme ends which shall house the control & space heater supply distribution system, Ethernet switches (provided by employer) and other LV equipment common for the board. (b) Each switchboard section shall be provided with two (2) Nos. of 240V DC / 120V DC feeders for the control supply. (c) The arrangement for receiving the above supply and distributing it to individual panels shall be provided by the Contractor in line with the drawing No. 0000-205-POE-A-013 enclosed. The diodes shall have a peak inverse voltage of 1000 Volts. Diode details like rated current, heat sink sizing & temperature, etc. shall be submitted for review and approval. (d) Contractor shall provide one 240V/63A single phase to neutral AC supply feeder per switchboard/Switchboard section for space heater supply. Contractor shall provide necessary switch and fuse to receive, isolate and distribute to each panel. (e) Power Supply to Numerical Relay and Ethernet switch shall be an independent circuit with switch and fuse tapped from the panel DC supply. Exact scheme for segregation of switchgear & numerical relay DC supplies shall be finalized during detailed engineering. (f) Each sub circuit shall have separate fuses. Fuse size shall be determined so as to achieve selective clearance between main circuit and sub circuit in case of fault. Potential circuits for protection and metering shall also be protected by separate fuse. (g) All fuses shall be of HRC link type conforming to IS: 13703 / 9385 mounted on suitable fuse bases. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage. All accessible live connection to fuse bases shall be adequately shrouded.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR	Page 15 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
4.11.00	(h) All DC circuits shall be fused on both poles. Single phase AC circuits shall have fuses on line and link on neutral. Space Heater (a) Each switchgear panel shall be equipped with thermostatically controlled space heater(s), suitably located in breaker / contactor and cable compartments to prevent condensation within the enclosure. The space heater shall be connected to 240V single phase AC auxiliary supply available in the switchgear, through switches and fuses provided separately for each panel. (b) For motor space heater supply, one breaker / contactor normally closed (NC) auxiliary contact of each motor feeder shall be wired out in series of switch fuse upto terminals block in the respective panels of switch boards. The motor space heater supply shall be taken from Panel space heater supply given to switch board. For DAF module the space heater circuit & its components shall be rated for min. 16A. (c) A 240V single phase 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF switch for connection of hand lamp.		
4.12.00	Terminal Blocks (a.) Terminal blocks shall be 650V grade, 10Amps rated, made up of unbreakable polyamide 6.6 grade. The terminals shall be either 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. (b.) Terminal blocks for CT and VT secondary leads shall be of stud type, made up of unbreakable polyamide 6.6 grade. They shall be provided with links to facilitate testing, isolation star / delta formation and earthing. Terminal blocks for CT secondary shall have the short circuiting facility. The terminals for remote ammeter connection etc. shall also be disconnecting type only. All metal parts shall be of non-ferrous material. Screws shall be captive. (c.) At least 10% spare terminals for external connections shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks. Space for adding another 10% spare terminals shall also be available in each panel. (d.) There shall be minimum clearances of 250 mm between the terminal blocks and the cable gland plate and 150 mm between two rows of terminal blocks. (e.) All panel wiring for external connections shall terminate on separate terminal blocks which shall be suitable for connecting two (2) stranded copper conductors of 2.5 sq. mm on each side, or alternatively, the terminal blocks shall have the possibility of double shorting space to facilitate looping.		
4.13.00	Switchgear Wiring (a.) All Switchgear panels shall be supplied completely wired internally upto the terminal block ready to receive external cabling. All inter cubicle wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided / done by the Contractor.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR Page 16 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
4.14.00	(b.) All internal wiring shall be carried out with 650 V grade, single core, 1.5 sq. mm. stranded copper wires having minimum of seven strands per conductor and color coded, PVC insulation. CT circuits shall be wired with 2.5 sq. mm. wires which otherwise are similar to the above. Extra flexible wires shall be used for wiring between fixed and moving parts such as hinged doors. (c.) All wiring shall be properly supported neatly arranged, readily accessible and securely connected to equipment, terminals and terminal blocks. Wiring troughs or gutters be used for this purpose. (d) Inter-panel wiring for distribution of space heater supply shall be done with copper wires of adequate cross-section to carry the total current of all panel as well as motor space heaters (e) Internal wire terminals shall be made with solderless crimping type tinned copper lugs which shall firmly grip the conductor. Insulation sleeves shall be provided over the exposed parts of lugs. (f) Printed single tube ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The wire identification marking shall be in accordance with IS: 375. Red Ferrules should be provided on trip circuit wiring. (g) Interconnection to adjacent panels shall be brought out to a separate set of terminal blocks located near the slots or holes, meant for the interconnecting wires. Arrangement shall permit neat layout and easy interconnections to adjacent panels at site and wires for this purpose shall be provided by Contractor looped and bunched properly inside the panels. (h) Contractor shall be fully responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment. (i) The Contractor shall provide the necessary clamps wiring troughs etc. for all wiring in side the switchgear enclosed including the Contractor's power and control cables.			
	Power Cable Termination (a.) Cable termination compartment shall receive the Contractor's stranded Aluminium conductor, XLPE insulated, shielded, armored / unarmored, PVC jacketed, single core / three core, unearthed / earthed grade power cable(s). (b.) A minimum clearance of about 600 mm shall be kept between the cable lug bottom ends and gland plates for stress cone formation for XLPE cables. Interphase clearance in the cable termination compartment shall be adequate to meet electrical and mechanical requirement besides facilitating easy connections and disconnection of cables. Dimensional drawing of cable connection compartment showing the location of lug, glands, CTs, gland plates etc. and the electrical clearances available shall be submitted for owner's approval during detail engineering. (c.) Cable termination compartment shall have provision for termination of power cables of sizes as indicated during detailed engineering with removable undrilled gland plates. For all single core cables gland plates shall be of nonmagnetic material. Cable entry shall be from bottom. Any change will be intimated later.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR	Page 17 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC								
4.15.00	Name Plates and Labels a. Each switch board shall have a name plate for its identification. All enclosure mounted equipment hall be provided with individual engraved name plates for clear equipment identification. All panels shall be identified on front as well as backside by large engraved name plates giving the distinct feeder description along with panel numbers. Back side name plates shall be fixed in panel frame and not on the rear removable cover. b. Name plate shall be of non-rusting metal or 3-ply lamicoid with white engraved letterings, on black background. Letter size shall be of at least 10mm height. c. Suitable stenciled paint mark shall be provided for identification of all equipment, located inside the enclosure, as well as for door mounted equipment, from the back side in addition to plastic sticker labels, if provided. These labels shall be located directly by the side of the respective equipment, shall be clearly visible and shall not be hidden by equipment wiring. Labels shall have device number as mentioned in wiring drawings. Type of labels and fixing of labels shall be such that they are not likely to peel off / fall off during prolonged use.											
4.15.1	Circuit Breaker Module All circuit breaker modules shall have the following accessories: Current / Voltage transformers as per requirement Relays as per relevant clauses / single line diagrams Spring charging motor, with its protection and control Auxiliary contacts. Terminal blocks Refer module tender drawings at Page No. 24 of 34 to 34 of 34											
4.15.2	P.T. Module Type - G <table><thead><tr><th>Item Description</th><th>Module G</th></tr></thead><tbody><tr><td>1 phase VT*</td><td>3</td></tr><tr><td>Fuses (VT Primary)</td><td>3</td></tr><tr><td>Fuses (VT Secondary)</td><td>6</td></tr></tbody></table> * 3.3 kV System the VT ratio is 3.3/ $\sqrt{3}$ KV / 110/ $\sqrt{3}$ V * 11kV System the VT ratio is 11/ $\sqrt{3}$ KV / 110/ $\sqrt{3}$ V				Item Description	Module G	1 phase VT*	3	Fuses (VT Primary)	3	Fuses (VT Secondary)	6
Item Description	Module G											
1 phase VT*	3											
Fuses (VT Primary)	3											
Fuses (VT Secondary)	6											
4.15.3	Contactor Module – CC All Contactor modules shall have the following accessories:											
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR								
Page 18 of 39												

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	- Power Contactors with HRC Fuses - Current / Voltage transformers as per requirement - Numerical Relays as per relevant clauses / single line diagrams - Spring charging motor, with its protection and control - Auxiliary contacts. - Terminal blocks			
5.00.00	NUMERICAL RELAYS			
5.1.00	General requirements			
5.1.1	All Numerical relays shall be of types, proven for the application satisfying requirements specified elsewhere and shall be subject to Employer's approval. Numerical Relays shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach and other characteristics to provide required sensitivity to the satisfaction of the Employer.			
5.1.2	All numerical relays shall be rated for control supply voltage as mentioned elsewhere under system parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Contacts for breaker / vacuum contactor close and trip commands shall be so rated as to be used directly used in the closing and tripping circuits of breaker / vacuum contactor without the need of any interposing / master trip relays. Threshold voltage for binary inputs shall be suitably selected to ensure avoidance of mal operation due to stray voltages and typically shall be more than 70% of the rated control supply voltage.			
5.1.3	One minute power frequency withstand test voltage for all numerical relays shall at least be 2kV (rms).			
5.1.4	All IEDs shall have freely programmable optically isolated binary inputs (BI) and potential free binary output (BO) contacts, the minimum quantity of which is as follows. (a) Motor feeder – 10 BI + 8 BO (b) Transformer feeder – 12 BI + 6 BO (c) Incomer, Bus-coupler, Tie feeder – 14BI + 8 BO (d) Board IED (Switchgear Control Unit) – 32 BI + 32 BO The above quantities are only indicative and shall be finalized during detailed engineering .In case the offered IED does not have the required number of I/Os ,the same can be achieved through external I/O device of same make complying with the requirement stated elsewhere in this specification.			
5.1.5	Failure of a control supply and de-energization of a relay shall not initiate any circuit breaker / vacuum contactor operation.			
5.1.6	Disturbance Record waveforms, event records & alarms shall be stored in Non-volatile memory and failure of control supply shall not result in deletion of any of these data.			
5.1.7	All the numerical relays shall have communications on three ports, local front port communication to laptop and dual ports on IEC 61850 to communicate with the employer's data concentrator through LAN. The dual IEC 61850 ports shall be connected to two separate Ethernet switches (provided by employer) to form part of the Switchgear SCADA.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR
Page 19 of 39				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.1.8	All Numerical relays shall have features for electrical measurements including voltage, current, power (active & reactive), frequency, power-factor and energy parameters.			
5.1.9	Relays shall have event recording feature, recording of abnormalities and operating parameters with time stamping.			
5.1.10	Master trip (86) and non-86 trips shall be software configurable to output contacts and no separate master trip relay shall be used.			
5.1.11	All numerical relays shall have provision of both current (CT) and voltage (VT) inputs. Relays shall be suitable for both residually connected neutral CT input as well as CBCT input. Relays shall be suitable for CT secondary current of 1A. Relays for transformer feeders without differential shall have 5 CT inputs (3 – Phase, 1 – CBCT, 1 – REF). Relays for transformer feeders with differential protection shall have 9 CT inputs (6 – Phase, 1 – CBCT, 1 – REF, 1 – Standby Earth Fault). Motor relays shall have 4 & 7 CT inputs for non-differential & differential application respectively. Relays for Incomers, Bus-couplers & Ties shall have 4 CT inputs. All relays except incomers, ties and bus-couplers shall have 3Nos of VT inputs. Relays used in incomers, ties and bus couplers shall have provision of two sets of voltage inputs (3Nos for bus voltage & 1No. for line voltage) for the purpose of synchronization.			
5.1.12	All CT terminals on the relays shall be of fixed type suitable for connection of ring-type lugs to avoid any hazard due to loose connection leading to CT open-circuit. In no circumstances Plug In type connectors shall be used for CT / VT connections.			
5.1.13	All numerical relays shall have key pad / keys to allow relay setting from relay front. Pre-programmed or programmable key for Master trip (86) reset shall be provided on the relay front. Relay to be self or hand reset shall be software selectable. Manual resetting shall be possible from remote.			
5.1.14	Relays shall have suitable output contact for circuit breaker failure protection (CBFP).			
5.1.15	Relays shall have self diagnostic feature with continuous self check for power failure, program routines, memory and main CPU failures and a separate output contact for indication of any failure.			
5.1.16	Relays shall have at least two sets or groups of two different sets of adaptable settings. Relays shall have multiple IEC / ANSI / user-programmable characteristics.			
5.1.17	Design of the relay must be immune to any kind of electromagnetic interference. Vendor to submit all related type test reports for the offered model along with the offer.			
5.1.18	All cards/ hardware of numerical relays shall be suitable for operation in Harsh Environmental conditions with respect to high temperature, humidity & dust.			
5.2.00	Protections: Relay Types & Protections			
5.2.1	Motor Feeder Protections (Module Type DA/DAF/CC) The Motor protection relay shall be suitable for providing the following protections a) Thermal Overload Protection (49) The relay shall have adjustable thermal curve as per parameters. Separate prior alarm and trip outputs shall be available. b) Short Circuit Protection (50) The relay shall have instantaneous short-circuit protection. Provision for blocking of short-circuit protection shall be available to make relay suitable for contactor-controlled motors. The short circuit protection shall also have cold load pick up (doubling) / group-changeover			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR
Page 20 of 39				

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
5.2.2	feature to allow higher setting during motor start and lower setting during normal running condition. c) Earth Fault Protection (50N) The relay shall have instantaneous as well as time delayed earth fault protection. With CBCT the relay shall be suitable for detection of earth fault currents in the range of 1% (10mA). Provision should be provided to block earth fault element in case of phase current exceeding 4 times of full load current when used for contactor-controlled motors. d) Negative Phase Sequence Protection (46) The relay shall have negative phase sequence (unbalance) protection to protect the motor against overheating caused by phase unbalance / negative sequence current. e) Locked Rotor Protection (50LR) The relay shall have locked rotor protection to take care of stalling of motor during motor start up. The protection shall take care of the prolonged motor start up time under bus low-voltage conditions. The relay shall have provision to accept speed switch input to enable to use relay for applications where the safe stall time of motor is shorter than the start-up time of the motor. f) Motor start monitoring & Restart inhibit feature The relay shall have a function block for monitoring motor start-up condition with suitable outputs for use in various logics. A thermal based restart inhibit feature with separate settings shall be provided. It shall be possible to configure the output of this function to block closing command during restart inhibit period. Estimated time to the next motor restart should be available for display. g) Number of starts limitation (66) The relay should have repetitive start protection to protect the motor against overheating caused by too frequent start-up attempts. The output of this function block should be routed to restart inhibit output. h) Under Voltage protection with time delay (27M) The relay should have under voltage protection with built in variable timer. The protection should be sensed through bus VT voltage provided to relay. i) Motor Differential protection (87M) Differential protection for motors rating 2MW and above shall be provided with high stability circulating current differential protection with harmonic restraint having pick up setting range of 10 to 40 % of CT secondary. Necessary series stabilizing resistors and metrosils shall also be provided. j) VT Fuse-fail protection (60) Built in fuse fail protection should be available in relay, which should block under voltage protection in the event of fuse fail. The relay should have built in Lockout feature. Transformer Feeder Protections (Module Type DB/DBF/CCT) The Transformer protection relay shall be suitable for providing the following protections. a) Three Phase Over current and Earth Fault protection (50 & 50N) The relay shall have instantaneous as well as time delayed over current and earth fault protections. The over current element should have the minimum setting adjustable between 250-2000% of CT secondary rated current. The short circuit protection shall also have cold load pick up (doubling) / group-changeover feature to allow higher setting during transformer charging (inrush) and lower setting during normal operating condition.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR	Page 21 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	With CBCT the relay shall be suitable for detection of earth fault currents in the range of 10mA secondary. b) Restricted Earth Fault protection (64R) Restricted earth fault protection (64R) shall be provided with high stability circulating current principle having pick up setting range of 10 to 40 % of CT secondary. Necessary stabilizing resistors shall be provided. c) Stand by earth fault protection (51N) For transformers of rating 5MVA and above, definite time delayed Stand by earth fault protection shall be provided having a pick up setting range of 10% to 40% with a timer delay of 0.3 sec to 3 sec. d) Transformer Differential protection (87T) Differential protection for transformers (87T) of rating 5MVA and above shall be provided with stabilized biased differential relay. The differential protection shall be provided with harmonic restraint during switching and over fluxing condition. No ICT shall be provided either for ratio correction or for transformer primary and secondary correction. The necessary correction shall be programmable at offered numerical relay. Sensitive phase current and phase angle displays should be available to facilitate the commissioning and checking of the measurement circuit connection and vector group matching. e) Transformer trouble trips Transformer troubles like Buchholz, Winding temperature, Oil temperature & Pressure Relief Device trips shall be wired to separate binary inputs of the relay and shall be configured to issue trip command to the breaker. f) Transformer trouble Alarm Alarm contacts of the above transformer troubles shall be wired to separate binary inputs of the relay for communication to HMI / DDCMIS.			
	5.2.3	Protections for Incomers, Bus-couplers and Tie feeders (Module Type DC/DE/DD) The Incomer, Bus Coupler & Tie feeder protection relay shall be suitable for providing the following protections a) Three Phase Over current and Earth Fault protection (50 & 50N) The over current element should have the minimum setting adjustable between 250-2000% of CT secondary rated current. The earth fault element should be suitable for residually connected CT input. The relay shall be suitable for detection of earth fault currents in the range of 5% to 10% of the CT rated current. b) Synchronizing Check (25) Synchronizing check feature as a part of manual live change over and dead bus closing feature shall be provided. c) Bus No-volt Bus no volt signal shall be configured in the relay for use in control logics.		
	5.3.00	Other Protections and Control features		
	5.3.1	Control of breakers / vacuum contactors shall be carried out from the HMI station of Switchgear SCADA system through the LAN and the numerical relays as well as from DDCMIS through hardwired control commands in the form of 24V DC signal. Preferably, binary input of all relays shall be configurable to accept 24V DC signals directly from DDCMIS and no separate coupling relays shall be provided.		
	LOT-1A PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.3.2	Trip circuit supervision shall be provided for all feeders to monitor the circuit breaker / contactor trip circuit both in pre-trip and post-trip conditions.			
5.3.3	Schematics requiring auxiliary relays / timers for protection function shall be a part of numerical relay. The number of auxiliary relay and timer functions shall be as required for the application. Timer functions shall be configurable for on & off delays as per requirement.			
5.3.4	The numerical relay shall be able to provide supervisory functions such as trip circuit monitoring, circuit breaker status monitoring, VT and CT supervision.			
5.3.5	The numerical processor shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery backup for real time clock in the event of power supply failure shall be provided.			
5.3.6	At least 200 time tagged events / records shall be stored with time stamping. Details of at least 5 previous faults including the type of protection operated, operating time, all currents & voltages and time of fault.			
5.3.7	Diagnostics Automatic testing, power on diagnostics with continuous monitoring to ensure high degree of reliability shall be shall be provided. The results of the self reset functions shall be stored in battery back memory. Test features such as examination of input quantities, status of digital inputs and relay outputs shall be shall be available on the user interface			
5.3.8	The alarm / status of each individual protection function and trip operation shall be communicated to the Switchgear SCADA system.			
5.3.9	Sequence of events shall have 1ms resolution at device level.			
5.3.10	Measurement accuracy shall be 1 % for rated RMS Current and voltage			
5.3.11	It shall be possible to carryout open / close operation of breakers from a laptop by interfacing from the relay front port during initial commissioning.			
5.3.12	4-20mA analog output (current signal) for use - in DDCMIS shall be provided in all breakers. This may be provided as analog output from the Numerical relay or may be generated using a suitable CT & Current transducer. In case analog output is not available in the relay, the same may be achieved using external I/O device of same make complying with the requirement stated elsewhere in this specification. In addition, any other requirement of digital & analog signals for process controls shall be taken care.			
5.3.13	Additional GOOSE Controls shall be configured in the Numerical Relays for following functions. The response time of GOOSE interlocks shall be 10ms. (GOOSE Performance Class P1, Message Type 1A)			
	a) Inter tripping			
	b) Reverse Blocking			
	c) Earthing Interlocks			
5.4.00	NETWORKING			
5.4.1	Adequate space in the LV panel shall be identified for mounting of at least 2 Nos of employer's Ethernet Switches (19" rack mounting) in all switchgears. Further, mounting of Ethernet switch in the above compartment and inter-panel wiring of Ethernet cable for connection of all numerical relays on the switchgear to the Ethernet switches shall be in the contractor's scope. Arrangement to provide required control supply to Ethernet switch shall be made in the switchgear.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR
Page 23 of 39				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.00.00	TESTS			
6.1.00	Type Tests			
	GENERAL			
	(a.) All equipments to be supplied shall be of type tested design. The Contractor shall submit for owner's approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to 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. (b.) In case the Contractor is not able to submit report of the type test(s) conducted not earlier than ten years prior to 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 at no additional cost either at third party lab or in presence of client/owner's representative and submit the reports for approval. (c.) All routine tests as per the specification and relevant standards shall be carried out.. a) The following type test reports on circuit breaker / circuit breaker panels, of each voltage class and current rating shall be submitted 1) Short circuit duty test on circuit breaker, mounted inside the panel offered along with CTs, bushing and separators. 2) Short time withstand test on circuit breaker, mounted inside panel offered together with CTs, bushings and separators. 3) Power frequency withstand test on breaker mounted in side panel. 4) Lightning impulse withstand test on breaker mounted in side panel. 5) Temperature rise test on breaker and panel together. For this test, the test set up shall include three panels with breakers, the test breaker and panel being placed in the centre. The adjacent panels shall also be loaded to their rated current capacity. Alternatively the test panel may be suitably insulated at the sides, which will be adjoining to other panels in actual site configuration 6) Internal Arc Test as per IEC 62271-200 7) Measurement of resistance of main circuit. 8) Mechanical operation test. b) The following type tests reports on Contactor and Contactor panels of each type and rating shall be submitted. 1) Verification of rated making and breaking capacities of the contactor.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUB SECTION-II-E9 HT SWITCHGEAR	Page 24 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	2) Short time withstand test of panel. 3) Power frequency test on the contactor mounted in side panel. 4) Lightning impulse voltage withstand test of the contactor mounted in side panel. 5) Measurement of resistance of main circuit. 6) Test to confirm coordination between fuse and contactor. c) Short circuit withstand test of earthing device (truck / switch). For all important components like Surge Arrestors, Numerical relays, Ethernet switches, Data concentrators & Fibre Optic cables, the contractor shall submit the reports of all the type tests as per applicable standards and carried out not earlier than ten years prior to 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 not earlier than ten years prior to 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 at no additional cost to the owner either at third party lab or in presence of client/owner's representative and submit the reports for approval. 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.			
6.2.00	Two (2) protected soft copies on CD-ROM of the approved test results shall be furnished with the equipment . These shall include complete reports and results of the routine tests and type tests (if the latter is carried out) on equipment. If the type tests are not conducted, the CDs shall contain copies of the results of type tests carried out on identical equipment earlier.			
6.3.00	Testing to observe compliance to degree of protection, shall be checked for each switch board enclosure and busbar chambers during routine inspection shall be as under. a.) IP -4X It shall not be possible to insert a one (1) mm. dia steel wire into the enclosure from any direction, without using force. b.) IP-5X It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.			
6.4.00	Routine Tests All acceptance and routine tests as per the specification and relevant standards IEC 62271-200 & IEC 62271-100 shall be carried out. An indicative lists of tests / checks is mentioned as QA chapter on HT switchgear. However, the manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR
Page 25 of 39				

CLAUSE NO.	TECHNICAL REQUIREMENTS				
6.5.3	(k)	Check electrical and mechanical interlocks provided.			
	(l)	Checks on spring charging motor, correct operation of limit switches and time of charging			
	(m)	Check vacuum			
	(n)	All functional checks.			
	Current Transformers				
6.5.4	(a)	Megger between windings and winding terminals to body.			
	(b)	Polarity tests.			
	(c)	Ratio identification checking of all ratios on all cores by primary injection of current.			
	(d)	Magnetisation characteristics & secondary winding resistance.			
	(e)	Spare CT cores, if any to be shorted and earthed.			
6.5.5	Voltage Transformers				
	(a)	Insulation resistance test.			
	(b)	Ratio test on all cores.			
	(c)	Polarity test.			
	(d)	Line connections as per connection diagram.			
7.0.0	Cubicle Wiring				
	(a)	Check all switch developments.			
	(b)	It should be made sure that the wiring is as per relevant drawings. All interconnections between panels shall similarly be checked.			
	(c)	All the wires shall be meggered to earth.			
	(d)	Functional checking of all control circuit e.g. closing, tripping interlock, supervision and alarm circuit including proper functioning of component / equipment.			
	(e)	Check terminations and connections.			
	(f)	Wire ducting			
	(g)	Gap sealing and cable bunching			
Training workshop at site for Switchgear					
Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M of MV Switchgears.					
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR	Page 27 of 39

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
8.0.0	The scope shall include Two No's of MV Switchgear workshops and Training for a batch of 20 Engineers and a separate batch of 20 supervisors/technicians for two(2) days in each workshop at Project site. One day shall be for class-room training & One day shall be for hands-on training on MV Switchgears. One such Workshop shall be organized before the commissioning of First MV Switchboard and the Second workshop shall be conducted before Unit Commissioning. Employer shall provide the required Infrastructure such as Training Conference room, Projection systems etc.			
	Training workshop at site for Numerical Relay Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M of Numerical Relays and trouble shooting. The scope shall include Two No's of Numerical Relay workshops and Training for a batch of 20 Engineers at Project Site for 2 days in each of workshop at project site. One day shall be for class-room training & One day shall be for hands-on training on Numerical Relays. One such Workshop shall be organized before the commissioning of First MV Switchboard and the Second workshop shall be conducted before Unit Commissioning. Employer shall provide the required Infrastructure such as Training Conference room, Projection systems etc.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUB SECTION-II-E9 HT SWITCHGEAR
Page 28 of 39				

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LEGEND DESCRIPTION

52	CIRCUIT BREAKER
42	CONTACTOR
S.A.	SURGE ARRESTOR
	CURRENT TRANSFORMER
	CORE BALANCE CURRENT TRANSFORMER
	VOLTAGE TRANSFORMER
50	TRIPLE POLE INSTANTENIOUS O/C PROTN.
51	TRIPLE POLE IDMTL/DMT O/C PROTECTION
50N	INSTANTENIOUS E/F PROTECTION
51N	IDMTL / DMT SENSITIVE E/F PROTECTION
49	THREE PHASE THERMAL O/L PROTN. WITH O/L ALARM & RESTART INHIBITE FUNCTION
50L/R	STALLING / LOCKED ROTOR PROTECTION
46	THREE PHASE NEGATIVE PHASE SEQUENCE PROTECTION
66	NUMBER OF START LIMITATION/REPATIVE START PROTECTION
2	TIME DELAY RELAY
60	FUSE FAILURE PROTECTION
87M	3 PHASE MOTOR DIFFERENTIAL PROTECTION

LEGEND DESCRIPTION

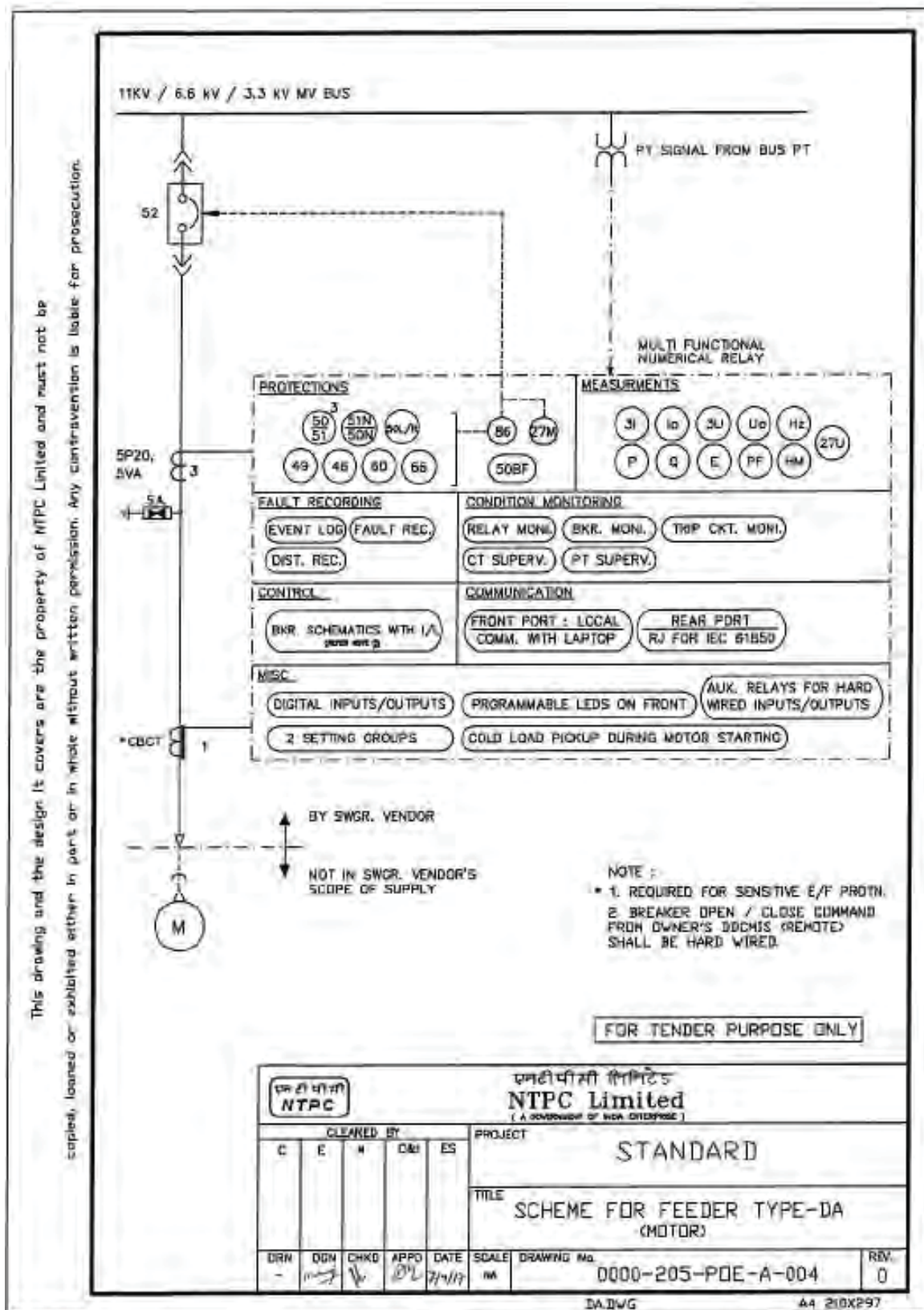
64R	RESTRICTED EARTH FAULT PROTECTION
51G	STAND BY EARTH FAULT PROTECTION
87T	3 PHASE BIASED TRANSFORMER DIFFERENTIAL PROTECTION
27M	3 PHASE UNDER VOLTAGE PROTECTION FOR MOTOR TRIPPING
27U	3 PHASE BUS UNDER VOLTAGE
27N	BUS NO VOLT PROTECTION
50BF	CIRCUIT BREAKER FAILURE PROTECTION
86	LOCKOUT FUNCTION
3I	3 PHASE CURRENT MEASUREMENT
Io	NEUTRAL CURRENT MEASUREMENT
3U	3 PHASE VOLTAGE MEASUREMENT
Uo	RESIDUAL VOLTAGE MEASUREMENT
P	ACTIVE POWER MEASUREMENT
Q	REACTIVE POWER MEASUREMENT
E	ENERGY MEASUREMENT
PF	POWER FACTOR MEASUREMENT
HZ	FREQUENCY MEASUREMENT
HM	HOUR RUN MEATER

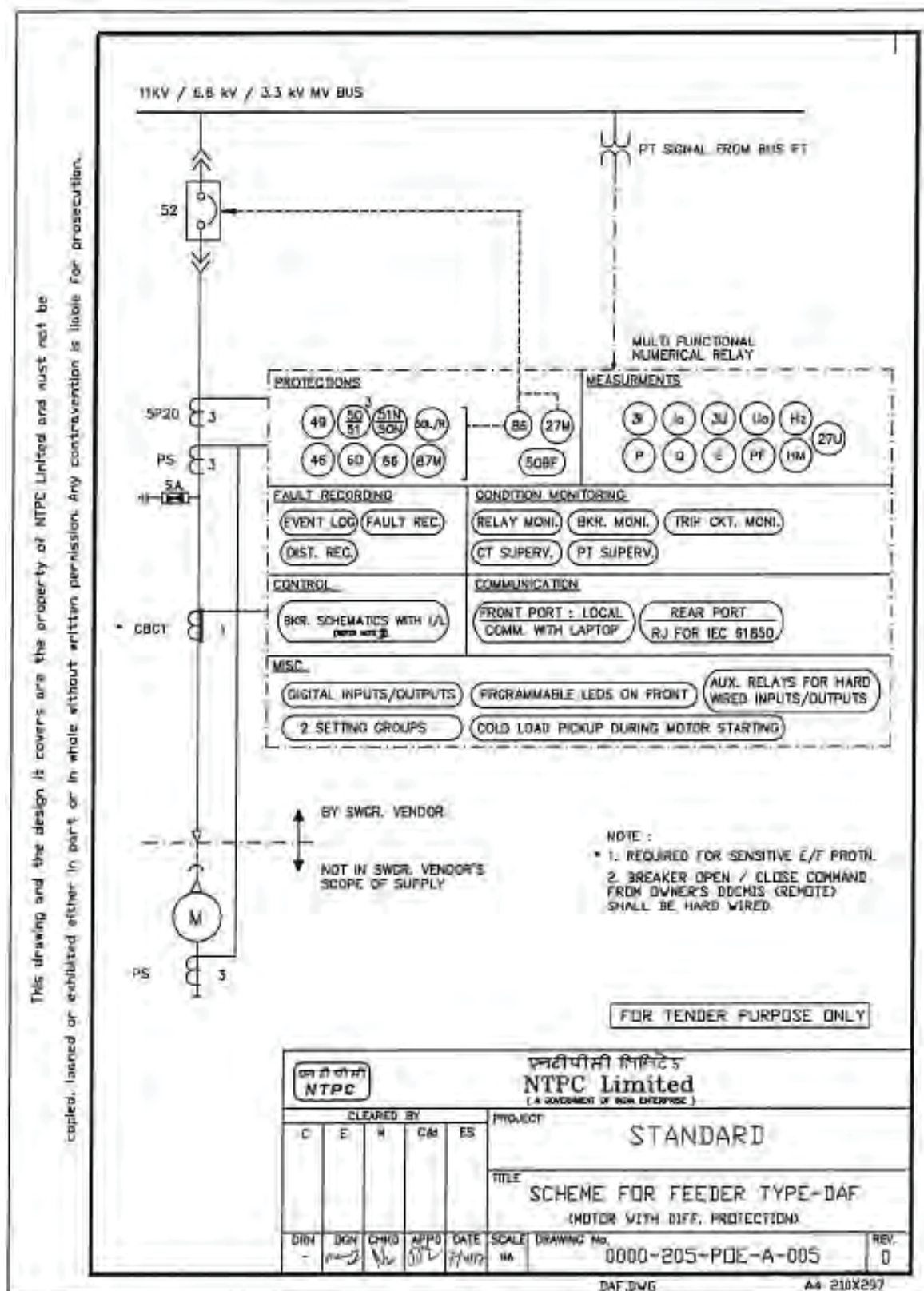
FOR TENDER PURPOSE ONLY

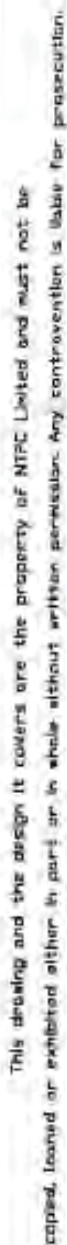
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				TITLE
				LEGEND DETAILS
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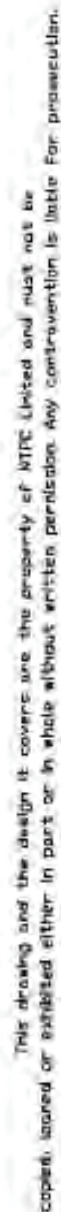
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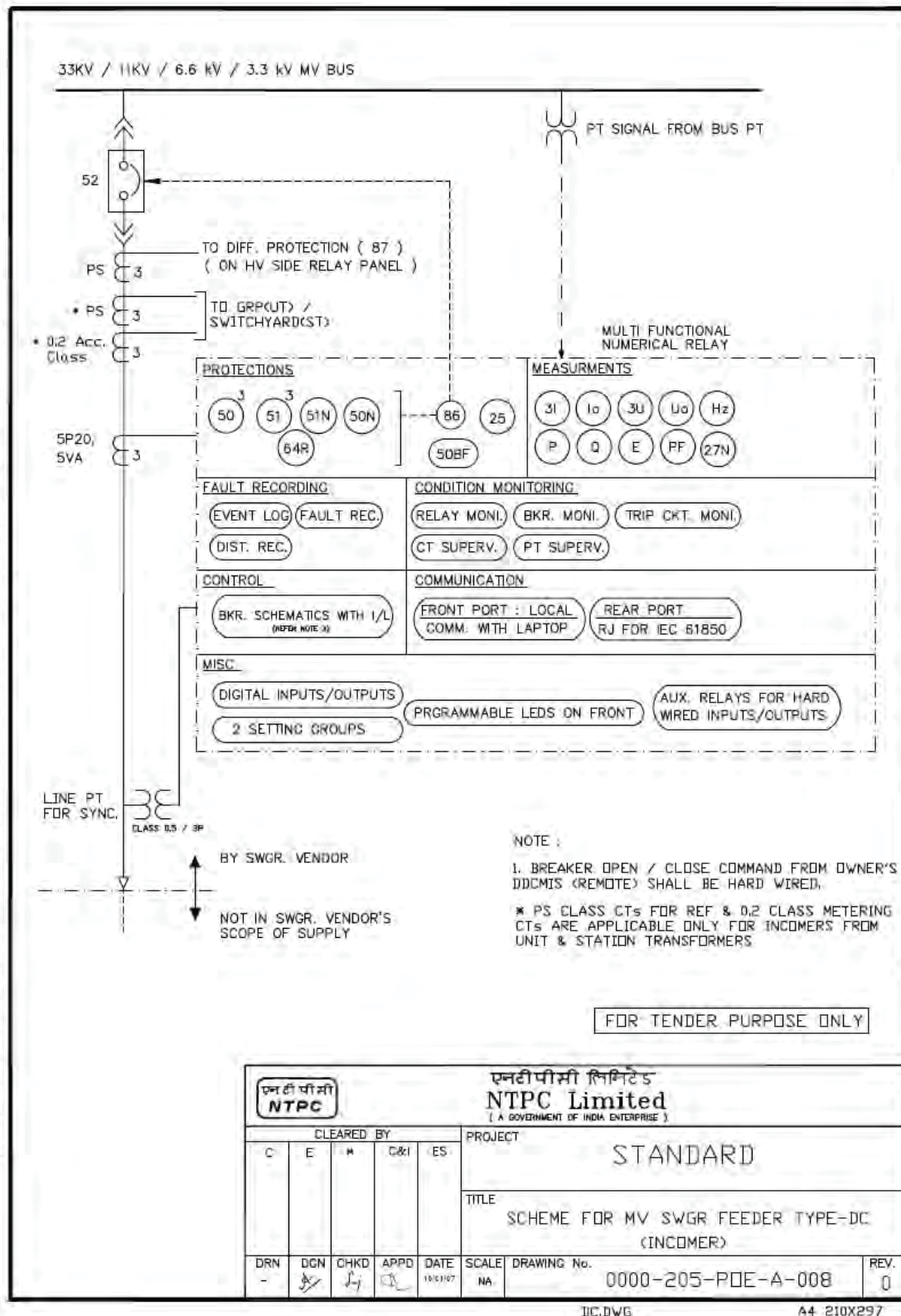




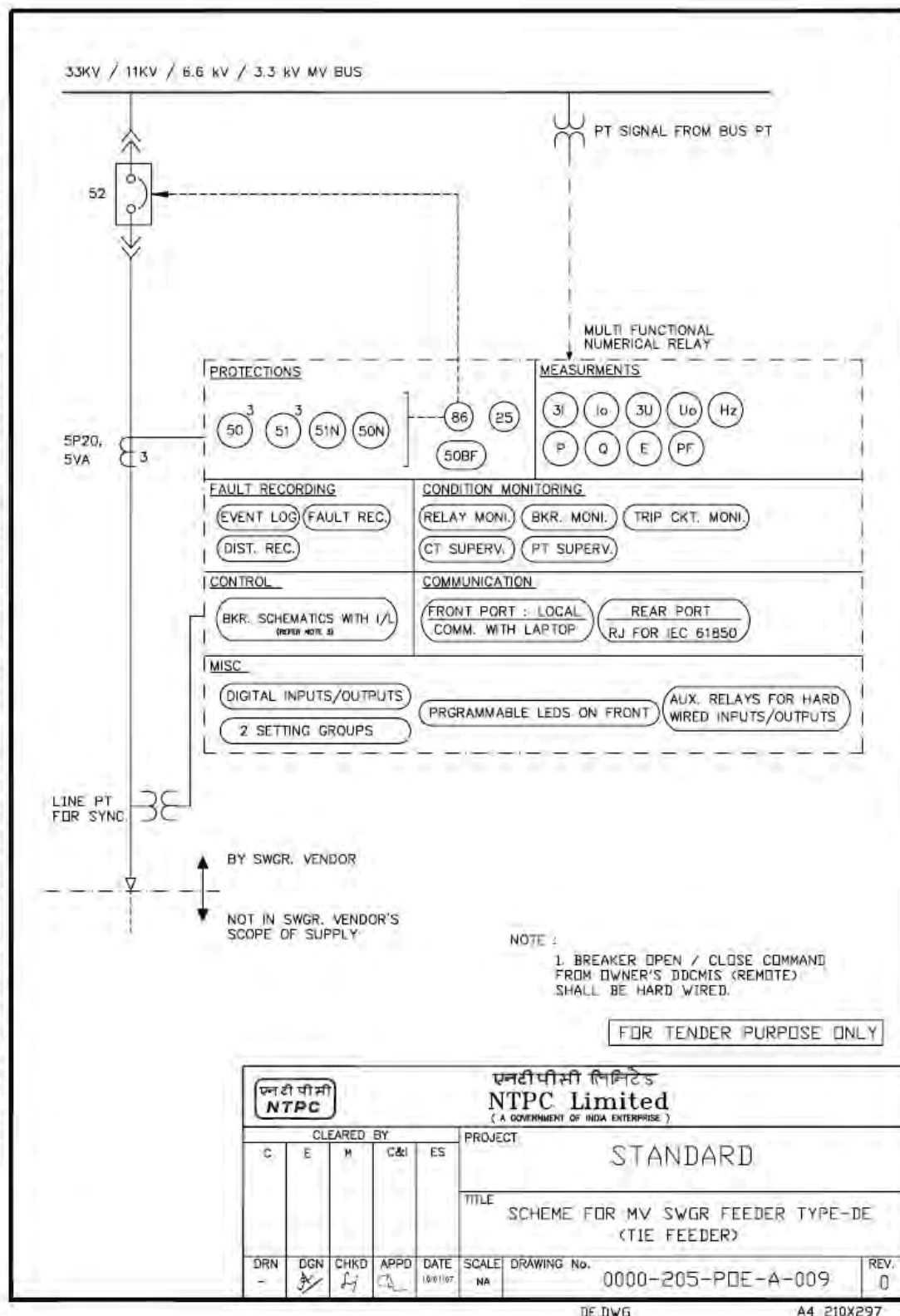




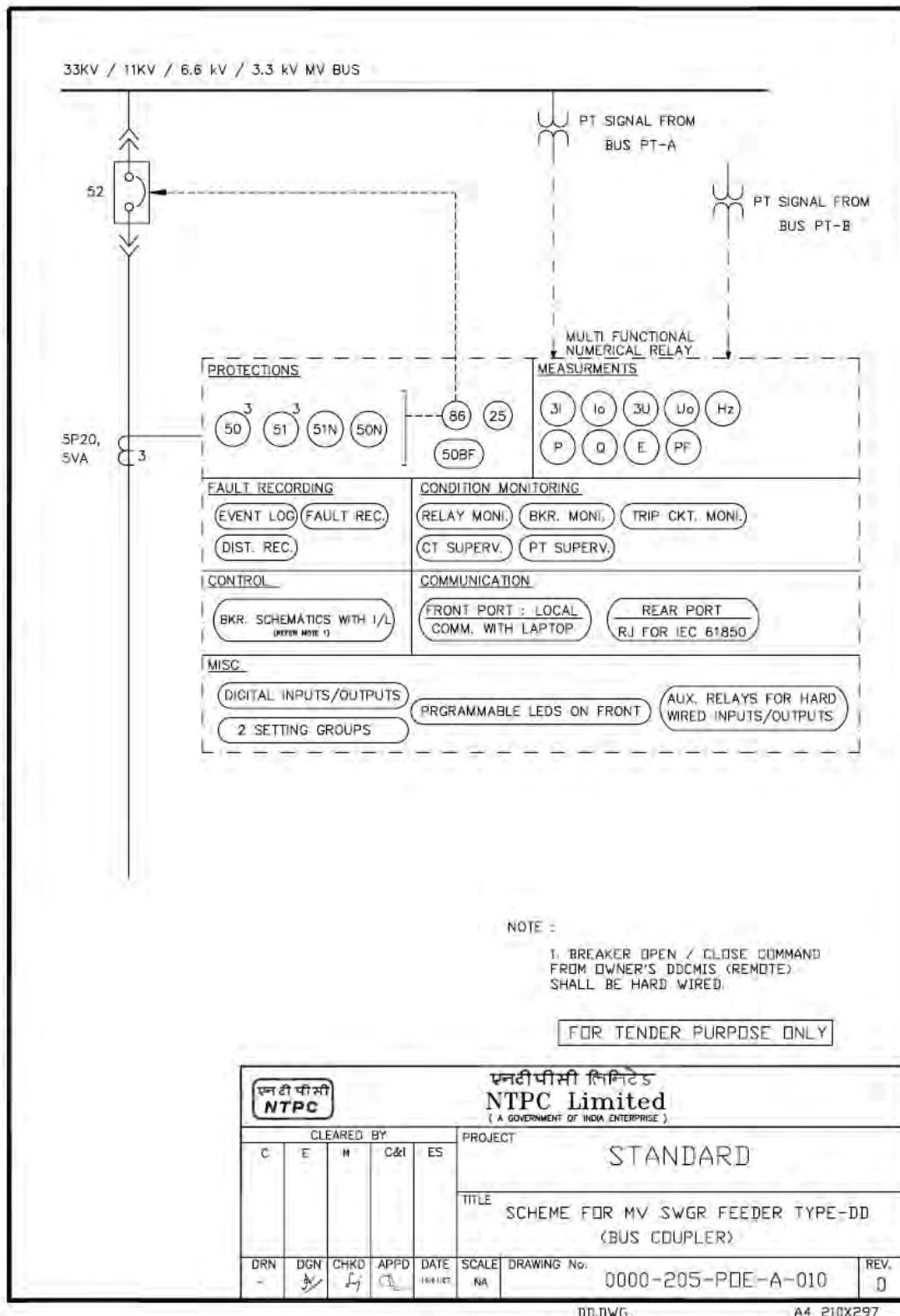
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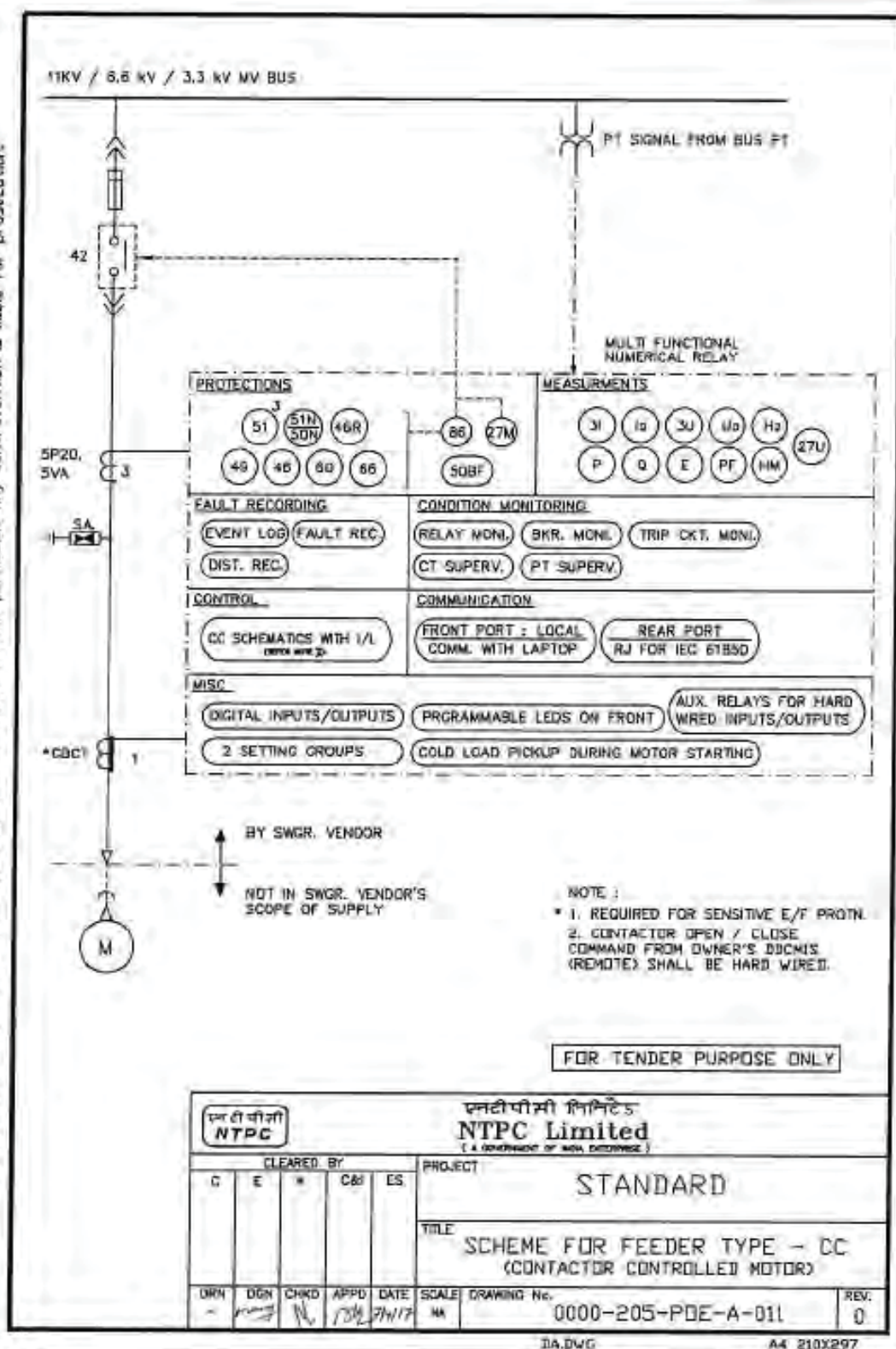
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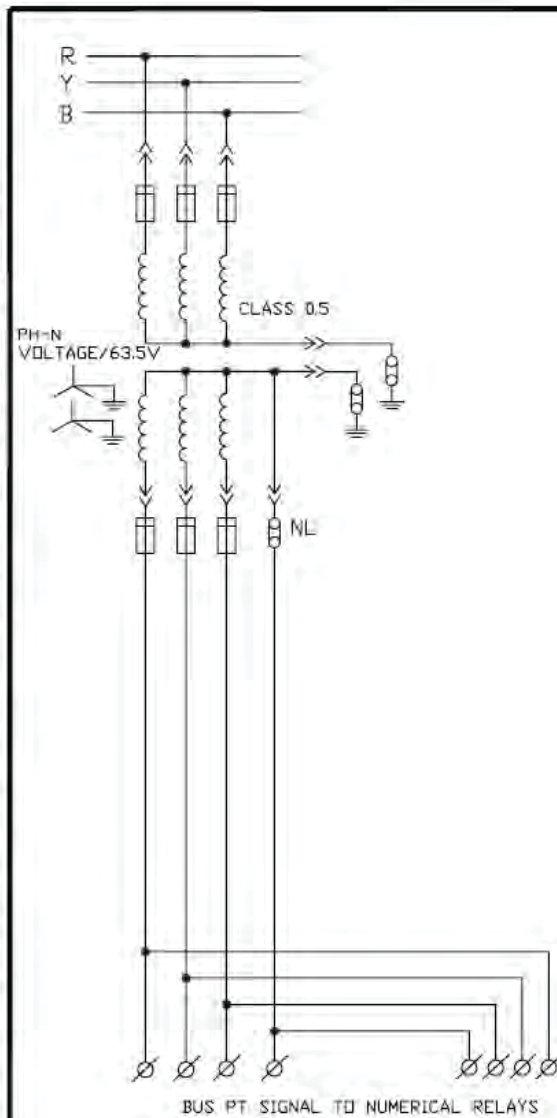
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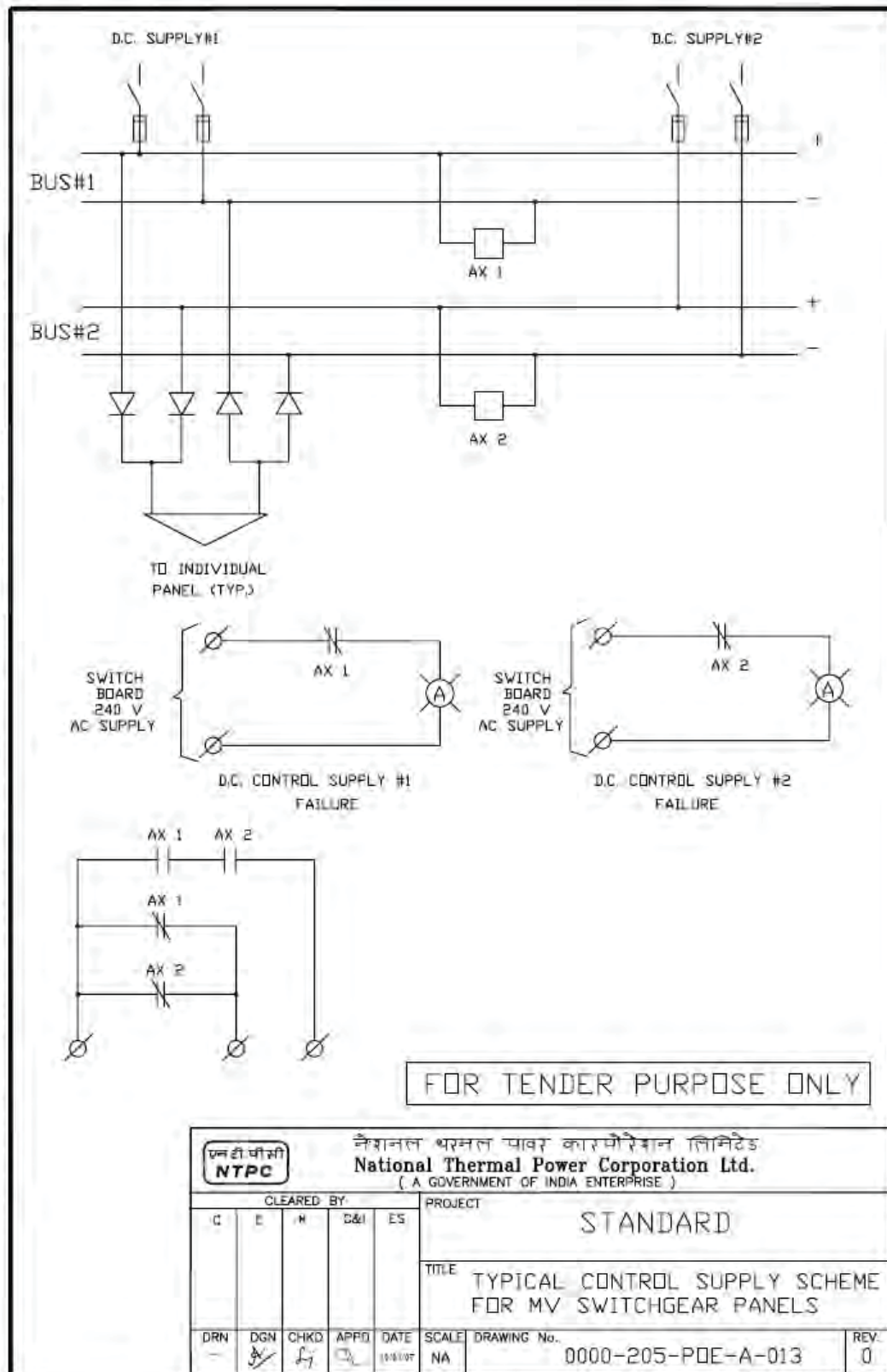


FOR TENDER PURPOSE ONLY

					एनटीपीसी लिमिटेड NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)				
Cleared By					PROJECT				
G	E	M	C&I	ES	STANDARD				
					TITLE				
					SCHEME FOR MV SWITCHGEAR MODULE TYPE - G (BUS PT)				
DRN	DGN	CHKD	APPD	DATE	SCALE	DRAWING No.	REV.		
-	✓	✓	✓	10/1/07	NA	0000-205-PDE-A-012	0		

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SUB-SECTION-II-E10

LT SWTIGCHGEAR & LT BUSDUCT

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
1.03.00	Spare capacity and Future Requirements All LV Switchboard shall be provided with spare feeders / modules as specified in relevant clause of Part-A of Technical Specification.			
1.04.00	Standardization It shall be preferred to have all LV Switchboards for the entire plant from a single manufacturer from maintainability and spares management point of view. It shall be preferred to follow a standardization of Terminal Numbers across all LV Modules for ease of Interconnection and maintenance.			
1.05.00	Plant control cable Interconnections Control cable interconnections between switchgears and transformer marshalling boxes, switchgears and motor terminal boxes / push button stations, and between various switchgears shall be in the contractor's scope. (a) Standard control cable sizes shall preferably be 3CX1.5, 5CX1.5, 7CX1.5 & 10CX1.5 mm ² (b) Cable size for motor space heater application shall be 2CX2.5 mm ² (c) Interconnections for Current Transformer terminals shall use two cores of 1.5mm ² size per phase (d) Core identification shall be using core colour for up to 5-core cable and core number for cable with more cores (e) Separate control cables shall be used for current transformers (f) Separate control cables shall be laid for EPB (Emergency/Local Push Button) status from EPB to Switchgear for the Switchgear and DCS.			
2.00.00	CODES AND STANDARDS			
2.01.00	All equipment shall, generally, comply with the updated issues of (a.) Applicable Indian Standards (b.) Indian Electricity Act. (c.) Indian electricity rules			
2.02.00	Equipment complying with any other authoritative / internationally recognized standards such as IEC, British, U.S.A., German, etc. will also be considered if it ensures performance equivalent or superior to Indian Standards. In such cases the contractor shall clearly indicate the standard adopted and furnish the copy of latest English version of the same along with the bid and bring out the salient features for comparison.			
2.03.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as published one month prior to the date of opening of bids. In case of conflict between this specification and those (IS codes, Standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following codes and standards.			
	IS: 5	Colours for ready-mixed paints and enamels.		
	IS: 694	PVC insulated cables for working voltages up to and including 1100V.		
	IS: 722	A.C. Electricity Meters		
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 2 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	IS: 1248	Electrical Indicating instruments	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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS PAGE 3 OF 58
	IS/IEC: 60947–1	Degree of protection provided by enclosures for low voltage Switchgear and Control gear	
	IS/IEC: 60947-2	A.C. circuit Breakers	
	IS: 2551	Danger Notice Plates	
	IS: 2629	Hot dip galvanising	
	IS: 2705	Current Transformers	
	IS/IEC: IEC-60947-4-1	Contactors and motors starter for voltages not exceeding 1000 V AC or 1200 V DC	
	IS: 3043	Code of practice for earthing.	
	IS: 3072	Code of practice for installation and maintenance of Switchgear	
	IS: 3156	Voltage Transformers	
	IS: 3202	Code of practice for climate proofing of electrical equipment.	
	IS: 3231	Electrical relays for power system protection.	
	IS/IEC 60947	Air-Break Switches, air break disconnectors, air break disconnector and fuse combination units for voltages not exceeding 1000V AC or 1200 V DC.	
	IS/IEC 60947-1 / IEC-60947-1	General Requirements for Switchgear and Control gear for voltages not exceeding 1000 V.	
	IS: 5082	Wrought Aluminium and Aluminium alloys for electrical purposes.	
	IS: 6005	Code of practice of phosphating of iron and steel.	
	IS/IEC 60947-5-1 / IEC-60947-5-1	LV switchgear and Control gear Control current devices and switching element.	
	IS: 8623 / IEC: 61439-1/2	Low Voltage Switchgear & Control gear assemblies	
	IS: 8686	Static Relays	
	IS: 13703 / IEC: 60269	HRC Cartridge fuses	
	IS: 10118 (4 parts)	Code of practice for selection, installation and maintenance of switchgear and control gear.	
	IS: 11171	Specification for dry type transformers.	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.04.00	METERS		
	1)	Accuracy class	2.0
	2)	One min. power frequency withstand test voltage	2.0 kV (rms)
3.05.00	Current Transformers		
	1)	Type	Cast Resin Bar Primary / Nylon Casing
	2)	Voltage class and frequency	650 V, 50 HZ
	3)	Class of insulation	E or better
	4)	Rated Secondary Current	1 A
	5)	Accuracy class & burden	
	a)	For protection	5P20, 5VA PS Class for REF
	b)	For metering	class 1.0, 5VA (min) class 0.2s, 5VA (min) for feeders indicated in SLD ,if any
	6)	Instrument Security Factor (ISF) for metering CT	5
	7)	Short time withstand	
	a)	For CT Associated with circuit breaker	50 kA(RMS) for 1 sec
	b)	For CT Associated with fuse protected feeders	Prospective current of 50 kA(RMS) for the Fuse clearing time
	8)	Dynamic withstand	
	a)	For CTs Associated with circuit breaker	105 kA(PEAK)
	b)	For CT Associated with fuse protected feeders	Prospective current of 105 kA(PEAK) as Limited by fuse
3.06.00	BUSDUCT		
	1)	Type	Non-Segregated
	2)	One minute power frequency withstand voltage	2.5 kV
	3)	One second short ckt withstand current	50 kA(RMS)
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS
			PAGE 6 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.07.00	4)	Momentary dynamic current withstand	105 kA(PEAK)	
	BUSDUCT (SANDWICH TYPE)			
	1)	Type	Bus Trunking	
	2)	Rated Insulation voltage	1000V	
	3)	One second short ckt withstand current	50KA(RMS)	
	4)	Momentary dynamic current withstand	105KA(PEAK)	
	5)	Power frequency withstand voltage	3.5kv	
	6)	Impulse withstand voltage	8kV	
	7)	Insulation	Class F	
	VOLTAGE TRANSFORMERS			
	1)	Type	Cast Resin	
	2)	Voltage Ratio	415 / 110 V for line PT 415/√3 / 110/√3 V for Bus PT	
	3)	Method of Construction	V-V	
	4)	Accuracy Class	0.5 0.2 for feeders indicated in SLD ,if any	
3.08.00	5)	Rated Voltage factor	1.1continuous, 1.5 for 30 sec.	
	6)	Class of insulation	E or better	
	7)	One minute power frequency withstand voltage	2.5 KV	
	HRC FUSES			
	1)	Voltage Class	650 Volts	
	2)	Rupturing capacity	80 kA (rms) for AC ckt. 20 kA for DC ckt.	
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 7 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
3.09.00	CONTACTORS 1) Type Air break electro magnetic 2) Utilising Category AC3 of IS/IEC 60947 for non reversible AC4 of IS/IEC 60947 for reversible drives		
3.10.00	Relays 1) Power frequency withstand voltage 2.5 kV for 1 sec. or 2.0 kV for 1 min.		
3.11.00	CONTROL TRANSFORMERS 1) Type Dry / Cast Resin 2) Voltage Ratio 415 / 110 with taps $\pm 5\%$ in steps of 2.5% 3) Class of insulation Class-B or better 4) One minute power frequency withstand voltage 2.5 kV 5) Rating 1.5 X Adequate for application.		
3.12.00	LIGHTING TRANSFORMER / WELDING TRANSFORMER 1) Type & Rating Dry type / 100 KVA(Welding TRF), 50KVA(Minimum)(Lighting TRF) 2) Voltage Ratio 415/415V, +/- 5% taps in steps of 2.5% 3) Class of insulation B or better 4) One minute power frequency withstand voltage 2.5 KV 5) Enclosure protection IP-42		
3.13.00	TRANSDUCERS 1) Current transducers a) Input 0-1 A (CT secondary) b) Rated frequency 50 Hz		
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS PAGE 8 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.14.00	c) Output	4-20 mA (2 Nos. decoupled)		
	d) Over current	Transducer for motor current ammeters shall be capable of withstanding min. 6 times CT sec. current of 1A for a min period of 30 seconds		
	e) Accuracy	1.0		
	2) Voltage Transducers			
	a) Input	110 V / 415 V / 240 V, 50 Hz (for AC) / 220 V / 110 V DC (for DC)		
	b) Output	4-20 mA (2 Nos. decoupled)		
	c) Accuracy	1.0		
	MCCB			
	1) Rated voltage	415V		
	2) Rated insulation level	690V		
3) Rated ultimate &Service S.C. breaking capacity	50 kA			
4) Rated making capacity	105 kA			
5) Utilization category	A			
4.00.00	CONSTRUCTIONAL DETAILS OF SWITCHBOARDS			
4.01.00	All Switchboards i.e., 415 V Switchgears, Motor Control Centres (MCCs), AC Distribution Boards (ACDBs), 220 V DC Distribution Boards (DCDBs) and Solenoid Valve Distribution Boards, shall be of metal enclosed, indoor, floor-mounted, free-standing type.			
4.02.00	All switchboard 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.			
4.03.00	All panel edges and cover / door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. The top covers of the panels should be designed such that they do not permanently bulge/ bend by the weight of maintenance personnel working on it.			
4.04.00	The switchboards shall be of bolted design. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cut-outs shall be true in shape and devoid of sharp edges.			
4.05.00	All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 5X as per IS/IEC 60947. However, the busbar chambers having a degree of protection of IP: 42 are also acceptable where continuous busbar rating is 1600A and above. Provision shall be made in all compartments for providing IP: 5X degree of protection, when circuit - breaker or module trolley has been removed. All cut-outs shall be provided with EPDM / Neoprene gaskets.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 9 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.06.00	Provision of louvers on switchboards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating is 1600 A and above.			
4.07.00	The switchboards shall comply to the Internal arc fault containment tests of 50 kA for 0.3s.			
4.08.00	The enclosure for outdoor panels shall be constructed of stainless steel sheets in order to have protection against corrosion. The Degree of protection for outdoor panels shall be IP: 55. The panels shall be mounted on a pedestal at a height of 500mm from ground level.			
4.09.00	All switchboards shall be of uniform height not exceeding 2450 mm. The height of the operating handle, push buttons etc shall be restricted between 300mm and 2000mm.			
4.10.00	Switchboards shall be easily extendable on both sides by the addition of vertical sections after removing the end covers.			
4.11.00	Switchboards shall be supplied with base frames made of structural steel sections, along with all necessary mounting hardware required for welding down the base frame to the foundation / steel insert plates. The base frame height shall be such that floor finishing (50 mm thick) to be done by Contractor after erection of the switchboards does not obstruct the movement of doors, covers, withdrawable modules etc.			
4.12.00	All switchboards shall be divided into distinct vertical sections (panels), each comprising of the following compartments: (a.) BUSBAR COMPARTMENT A completely enclosed bus bar compartment shall be provided for the horizontal and vertical bus bars. Bolted covers shall be provided for access to horizontal and vertical busbars and all joints for repair and maintenance, which shall be feasible without disturbing any feeder compartment. Auxiliary and power bus bars shall be in separate compartments. (b.) SWITCHGEAR / FEEDER COMPARTMENT All equipment associated with an incomer or outgoing feeder shall be housed in a separate compartment of the vertical section. Two-tier breaker arrangement in a vertical section shall be offered for outgoing breaker feeders of rating up to 1600A. The design of the vertical section for such an arrangement shall ensure ease of termination of power cables of size & quantity appropriate to respective feeder rating. The compartment shall be sheet steel enclosed on all sides with the withdrawable units in position or removed. Insulating sheet at rear of the compartment is also acceptable. No live parts shall be accessible with equipment drawn out and degree of protection within the compartment shall be IP2X. The front of the compartment shall be provided with the hinged single leaf door with captive screws for positive closure. (c.) CABLE COMPARTMENT OR CABLE ALLEY A full-height vertical cable alley of adequate width shall be provided for power and control cables. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations located in cable alley shall be designed to meet the Form 4b as per IEC 61439 for safety purpose. Necessary grommets shall be provided at the cable entry of individual modules. Wherever cable alleys are not provided for distribution boards, segregated cable boxes for individual feeders shall be provided at the rear for direct termination of cables. For circuit breaker external cable connections, a separately enclosed cable compartment shall also be acceptable. The contractor shall furnish suitable plugs to cover the cable openings in the partition between feeder compartment and cable alley. Cable alley door shall be hinged.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 10 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(d.) CONTROL COMPARTMENT A separate compartment shall be provided for relays and other control devices associated with a circuit breaker. 4.13.00 Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. EPDM / Neoprene gasket shall be provided between the panel sections to avoid ingress of dust into panels. 4.14.00 After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose. Wherever two breaker compartments are provided in the same vertical section insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit. 4.15.00 All 415V switchgear (circuit-breaker) panels shall be of single-front type. MCCs and DBs shall be of single-front / double-front construction as per the requirements. All single-front switch boards shall be provided with single-leaf, hinged or bolted covers at the rear. The bolts shall be of captive type. The covers shall be provided with "DANGER" labels. All panel doors shall open by 90 deg or more. In case of double-front MCCs, if this cannot be achieved for panels adjacent to a breaker panel, suitable dummy panel shall be provided by the Contractor wherever necessary. 4.16.00 All ACDBs, DCDBs and Solenoid Valve DBs shall be of fixed module type. All 415V circuit-breaker modules and contactor controlled motor modules shall be of fully draw-out type having distinct 'Service' and 'Test' positions. The equipment pertaining to a draw-out type incomer or feeder module shall be mounted on a fully withdrawable chassis which can be drawn out without having to unscrew any wire or cable connection. Suitable arrangement with cradle/ rollers, guides along with tool/lever operated racking in/out mechanism shall be provided for smooth and effortless movement of the chassis. For modules of size more than half the panel height, double guides shall be provided for smooth removal or insertion of module. All identical module chassis of same size shall be fully interchangeable without having to carry out any modifications. Suitable interlock shall be provided in DCDB for prevention of opening of Isolator (Incomer) when the bus coupler is open and vice-versa. 4.17.00 All draw-out modules shall be provided with "Closed door operation" feature wherein movement of the module from "Isolated" position to "Service" position & vice-versa and power ON / OFF operation of the module shall be possible only with the module door closed condition. 4.18.00 All disconnecting contacts for power and control circuits of draw-out modules shall be of robust and proven design, fully self-aligning and spring-loaded. Both fixed and moving contacts shall be silver-plated and replaceable. The spring-loaded power and control draw-out contacts shall be on withdrawable chassis and the same on fixed portion shall not be accepted. 4.19.00 Individual opening in the vertical bus enclosure shall permit the entry of moving contacts from the draw-out modules into vertical droppers. 4.20.00 As indicated in schematic drawings of DDCMIS controlled modules, contractor shall supply & mount two (2) coupling relays in the corresponding modules. 4.21.00 All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to Employer's approval. The Contractor shall submit dimensional drawings showing complete internal details of busbars and module components, for each type and rating for approval of Employer.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 11 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.22.00	Employer reserves the right to alter the cable entries, if required during detailed engineering, without any additional commercial implication.			
4.23.00	Each switchboard shall be provided with undrilled, removable type gland plate, which shall cover the entire cable alley. Contractor shall ensure that sufficient cable glanding space is available for all the cables coming in a particular section through gland plate. For all single core cables, gland plate shall be of non-magnetic material. The gland plate shall preferably be provided in two distinct parts for the easy of terminating addition cables in future. The gland plate shall be provided with gasket to ensure enclosure protection. Recommended drilling chart of gland plates for all power and control cables in the vertical panels shall be indicated by the Contractor in the respective G.A. drawings of the boards.			
4.24.00	The Contractor shall consider layout of panels in a switchboard consisting of various feeder modules in a straight line, unless specified otherwise. The actual composition and disposition of various modules in a switchboard shall be finalised during detailed engineering. The Contractor shall provide adopter panel / dummy panel required to meet various configuration / arrangement of busbars adopted by the Contractor. The Switchboards fed from indoor transformer will be flange connected to the same and the same shall be located as close as desirable to the transformer. The details of transformer flanges for those transformers not being supplied under this package shall be given to the contractor for matching the connections. The switchboards fed from outdoor transformers of rating 1000kVA and above shall be connected through busducts. For transformers of 1000kVA rating, cable connection may also be acceptable in case of layout constraints. For lower rated transformers, the connection shall be through cables. Busduct connections wherever applicable shall be preferably in a straight line alignment. Adopter panels and dummy panels shall be provided wherever required.			
4.25.00	Adequate space in a separate compartment shall be identified for mounting of Ethernet Switch (19" rack mounting), in all switchgears having numerical relays. Further, mounting of Ethernet switch in the above compartment at site and provision of inter-panel wiring (Cat5e Ethernet / Fibre Optic) for connection of numerical relays to Ethernet switch shall be in the contractor's scope. Arrangement to provide required control supply (110 V / 220 V DC) to Ethernet switch shall be made in the switchgear.			
4.26.00	CLEARANCES The minimum clearance in air between phases and between phases and earth for the entire run of horizontal and vertical busbars and bus-link connections at circuit-breaker shall be 25 mm. For all other components, the clearance between "two live parts", "a live part and an earthed part", shall be at least ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal and vertical busbars the clearances specified above should be maintained even when the busbars are sleeved or insulated. All connections from the busbars up to switch / fuses shall be fully shrouded / insulated and securely bolted to minimize the risk of phase to phase and phase to earth short circuits.			
5.00.00	PROTOTYPE PANELS In order to establish the compliance with the requirements of this technical specification, prototype panels shall be made and offered for the Employer's inspection and approval before the start of manufacturing of panels for this project. The exact configuration of such prototype panels shall be finalized during detailed engineering.			
6.00.00	CONSTRUCTIONAL DETAILS OF AC & DC FUSE BOARDS			
6.01.00	All fuse boards shall be metal enclosed, fixed type, non-compartmentalized construction, suitable for indoor/ outdoor mounting on wall or steel structure.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 12 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.02.00	The fuse board frame shall be fabricated using suitable mild steel structures or pressed and shaped cold rolled sheet steel of thickness not less than 2.0 mm. The frames shall be enclosed by cold rolled sheet steel of thickness not less than 1.6 mm.			
6.03.00	The fuse boards shall be provided with doors on the front. The doors shall preferably be in two halves with hinges at the extreme ends and locking facility at the centre.			
6.04.00	Suitable EPDM/Neoprene gaskets shall be provided to make fuse boards completely dust and vermin-proof with a degree of protection of IP-52 for indoor and IP-54 for outdoor application, as per IS/IEC 60947.			
6.05.00	Each DC fuse board shall comprise of the following : (a.) 1 no. 63 A switch as incomer (b.) 100 A fully insulated (PVC sleeved or epoxy coated) busbars. (c.) 8 nos. 16A outgoing Fuse feeders. (d.) 1 no. auxiliary contactor for supply monitoring. (e.) 1 no. indicating lamp with resistor and blue coloured lens.			
6.06.00	Each AC fuse board shall comprise of the following : (a.) 1 no. 63A TPN switch as incomer. (b.) 100 A, 3-phase, 4-wire, fully insulated (PVC sleeved or epoxy coated) busbars. (c.) 9 nos. 16 A single phase switch fuse units and 3 nos. 16 A TPN switch fuse units as outgoing feeders or alternatively 16 amps MCCB can be provided. (d.) 3 nos. indicating lamps with resistors and coloured lenses (R, Y, B) for incoming supply monitoring.			
6.07.00	The fuses shall be mounted in an insulating fuse carrier and it shall be possible to replace the outgoing feeder fuses without disturbing the other feeders. The handle of incoming switch shall be mounted on the door of the fuse board, with padlocking facility in both 'ON' and 'OFF' positions. The outgoing feeder switches shall preferably be of rotary type.			
6.08.00	Cable entry facilities shall be provided at bottom with removable gland plates of suitable thickness. However, top cable entry may be allowed in case of layout constraints. All incoming and outgoing cables shall be terminated on suitable terminal blocks.			
7.00.00	POWER BUSBARS AND INSULATORS			
7.01.00	All 415 V Switchboards, MCCs and ACDBs shall be provided with three phase and neutral busbars. Two separate sets of vertical busbars shall be provided in each panel of double front MCCs / DBs. Interleaving arrangement for busbars shall be adopted for switchboards with a rating of more than 1600A. DCDBs shall be provided with two (2) busbars. Entire busbar system shall be insulated with PVC sleeves. Busbar sleeves shall be compliant to UL224 (Extruded insulating tubing), CE/UL certified, having fire retardant properties and working temperature of 105°C.			
7.02.00	Vertical busbars of non-breaker panels shall be completely phase segregated by suitable insulating supports / walls made of fire-retardant, non-hygroscopic, track-resistant material to minimise the occurrence of arc faults.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 13 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS		
7.03.00	All busbars and jumper connections shall be of high conductivity Aluminium alloy / Copper of adequate size.		
7.04.00	The cross-section of the busbars shall be uniform throughout the length of switchboard section and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral busbar short circuit strength shall be same as main busbars.		
7.05.00	All busbars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength sheet moulded compound or equivalent type polyester fibre glass moulded insulator. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided, anti-tracking barriers shall be provided between the supports. Insulator and barriers of inflammable material such as Hylam shall not be accepted. The busbar insulators shall be supported on the main structure.		
7.06.00	All busbar joints shall be provided with high tensile steel bolts, belleville / spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated busbar joints shall be thoroughly cleaned at the jointed locations and suitable contact grease shall be applied just before making a joint. All bolts shall be tightened by torque spanner to the recommended value. The overlap of the busbars at each joint surface shall be such that the length of overlap shall be equal to or greater than the width of the busbar. All Copper to Aluminium joints shall be provided with suitable bimetallic washers.		
7.07.00	All busbars shall be colour coded as per IS: 375.		
7.08.00	The Contractor shall furnish calculations establishing the adequacy of bus bar sizes for specified current ratings.		
8.00.00	AUXILIARY BUSBARS AND CONTROL TRANSFORMERS		
8.01.00	AC CONTROL SUPPLY BUSBAR Each bus-section of all Switchgears and MCCs shall be provided with two (2) nos. 415V / 110V control transformers. The 110V AC control supply from the control transformers shall be run through the MCC by means of two sets of control supply busbars of electrolytic Copper. In case of one transformer failure, whole bus section can be fed through single transformer. The control supply to different modules shall be tapped individually from the control supply busbars.		
8.02.00	DC CONTROL SUPPLY BUSBARS Electrically controlled circuit breaker boards shall be provided with DC control supply busbars. The manually controlled breakers shall also be provided with such busbars in case relays are provided. Each section of the switchboard shall be provided with a DC supply by the Contractor. The Contractor shall provide suitable terminals, switch-fuse etc. to receive the DC supply and distribute the same through above mentioned control busbars to the required modules of the respective section. The DC control supply bus of one section shall be coupled to the control supply of other section through a switch located in the bus-coupler breaker panel. The DC supply to the bus-coupler breaker may be given from any of the control buses. For Emergency Switchgear, two DC supplies shall be provided along with suitable diodes for deriving the control supply through diode auctioneering. Power Supply to Numerical Relay and Ethernet switch shall be an independent circuit with switch and fuse tapped from the panel DC supply. Exact scheme for segregation of switchgear & numerical relay DC supplies shall be finalized during detailed engineering.		
8.03.00	SPACE HEATER BUSBARS Panel and motor space heaters shall be fed from separate AC auxiliary busbars running throughout the switchboard. The supply for these busbars shall be tapped from incomer, before the isolating switch/ circuit breaker. Incoming circuit to space-heater bus shall have an		
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS
			PAGE 14 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.04.00	isolating switch, HRC fuse and neutral link of suitable rating. Suitable terminals shall also be provided to facilitate energisation of space-heater bus from outside during long shutdowns of unit / switch-board. CONTROL TRANSFORMERS The control transformers shall be 415 V / 110 V with neutral point-earthed, of insulation class 'B' or better. The sizing of Control transformers shall be carried out by Contractor considering the actual load of power contactors, auxiliary contactors, indicating lamps and other equipment in the module circuit. An additional load of 15 watts should also be considered for each module, for remote auxiliary relays and lamps to be connected in the control circuit of modules. Contractor shall also ensure that control transformers are adequately designed for meeting the momentary loading requirements & the voltage drop during this condition shall not be more than 5%.			
9.00.00	EARTH BUS AND EARTHING			
9.01.00	A galvanized steel / Copper / Aluminium earth bus shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded / bolted to the framework of each panel and breaker earthing contact bar. Vertical earth bus shall be provided in each vertical section which shall in turn be bolted / welded to main horizontal earth bus.			
9.02.00	The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current to earth, as indicated in "Technical Parameters", without exceeding the allowable temperature rise.			
9.03.00	Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Contractor's earthing conductors. The horizontal earth bus shall project out of the switchboard ends and shall have predrilled holes for this connection. All joint splices to earth bus shall be made through at least two bolts, and taps by proper lug and bolt connection.			
9.04.00	All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosure framework and truck shall be maintained even after painting.			
9.05.00	The carriage and breaker frame shall get earthed while being inserted in the panel and positive earthing of the breaker frame shall be maintained in all positions, i.e. SERVICE & ISOLATED, as well as throughout the intermediate travel.			
9.06.00	Each module frame shall get engaged to the vertical earth bus before the disconnecting contacts on the module are engaged to the vertical busbars.			
9.07.00	All metallic cases of relays, instruments and other panel-mounted equipment shall be connected to earth by independent stranded Copper wires of size not less than 2.5 sq. mm. All the equipment mounted on the door shall be earthed through flexible wire/braids. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors, soldering is not acceptable. Looping of earth connections, which would result in loss of earth connections to other devices, when a device is removed, is not acceptable. However, looping of earth connections between equipment to provide alternative paths to earth bus is acceptable.			
9.08.00	VT and CT secondary neutral point earthing shall be at one place only, i.e. on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.			
9.09.00	All hinged doors having potential carrying equipment mounted on it shall be earthed by flexible wire/ braid. For doors not having potential carrying equipment mounted on it, earth continuity through scraping hinges/ hinge pins of proven design may also acceptable. The Contractor shall establish earth continuity at site also.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 15 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.00.00	Circuit Breakers			
10.01.00	Circuit breakers shall be three pole, air break, horizontal draw out type, and shall have fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified parameters of continuous current rating and fault making / breaking capacity only after provision of cooling fans or special device shall not be acceptable.			
10.02.00	Circuit breakers along with its operating mechanism shall be provided with suitable arrangement for easy withdrawal. Suitable guides shall be provided to minimize misalignment of the breaker.			
10.03.00	There shall be "SERVICE", "TEST" and "FULLY WITHDRAWN" positions for the breakers. In "Test" position the circuit breaker shall be capable of being tested for operation without energizing the power circuits i.e. the power contacts shall be disconnected, while the control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the "SERVICE", "TEST" or "FULLLY WITHDRAWN" position. It shall be possible to close the door in "Test" position. The circuit breaker rack in and rack out from Service to Test, Test to Isolated position or vice-versa shall be possible only in the door closed position.			
10.04.00	All circuit breakers shall be provided with "6 NO" and "6NC" potential free auxiliary contacts. These contacts shall be in addition to those required, for internal mechanism of the breaker and should be directly operated from breaker operating mechanism. In case the manufacturer does not have a proven arrangement for providing the required number of circuit breaker auxiliary contacts on the fixed portion of the cubicle, necessary electrically reset latched relays shall be provided complete with all wiring in series with service position limit switch contacts, for multiplying the circuit breaker mounted auxiliary contacts and provide 4 NO and 4 NC contacts. Separate limit switches, each having required numbers of contacts shall be provided in both "SERVICE" and "TEST" position of the breaker. All contacts shall be rated for making, continuously carrying and breaking 10 Amp at 240 V AC and 1 Amp (Inductive) at 240 V DC respectively.			
10.05.00	Suitable mechanical indications shall be provided on all circuit breakers to show "OPEN", "CLOSE", "SERVICE ", "TEST" AND "SPRING CHARGED" positions.			
10.06.00	Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half a cycle of rated frequency.			
10.07.00	All circuit breakers shall be provided with the following interlocks :			
10.07.01	Movement of a circuit breaker between "SERVICE" and "TEST" position shall not be possible unless it is in open position. Attempted withdrawal of a closed circuit breaker shall preferably not trip the circuit breaker. In case the offered circuit breaker trips on attempted withdrawal as a standard interlock, it shall be ensured that sufficient contact exists between the fixed and draw out contact at the time of breaker trip so that no arcing takes place even with the breaker carrying its full rated current.			
10.07.02	Closing of a circuit breaker shall not be possible unless it is in "SERVICE" position, "TEST" position or in "FULLY WITHDRAWN" position.			
10.07.03	Circuit-breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage, to cover the stationary isolated contacts when the breaker is withdrawn. It shall however be possible to open the shutters intentionally against pressure for testing purposes.			
10.07.04	A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 16 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.07.05	Circuit breakers shall be provided with coded key / electrical interlocking devices, as per requirements.			
10.08.00	Circuit breaker shall be provided with anti-pumping relay and trip free feature, even if mechanical anti-pumping feature is provided.			
10.09.00	Mechanical tripping shall be possible by means of front mounted Red "trip" push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.			
10.10.00	Complete shrouding / segregation shall be provided between incoming and outgoing bus links of breakers. In case of bus coupler breaker panels the busbar connection to and from the breaker terminals shall be segregated such that each connection can be approached and maintained independently with the other bus section live. Dummy panels if required to achieve the above feature shall be included in the Contractor's scope of supply.			
10.11.00	Circuit breaker shall be provided with Power operated mechanism as follows.			
	1.	Power operated mechanism shall be provided with a universal motor suitable for operation on 240 V DC / 240 AC Control supply, with voltage variation from 198 V to DC to 242 V DC . Motor insulation shall be class "E" or better.		
	2.	The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring at minimum available control voltage.		
	3.	Once the closing springs are discharged, after one closing operation of circuit breaker, it shall automatically initiate recharging of the spring.		
	4.	The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.		
	5.	Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.		
	6.	All circuit breakers shall be provided with closing and trip coils. The closing coil shall operate correctly at all values of voltage from 187-242 V DC. The trip coil shall operate satisfactorily at all values of voltage from 154-242V DC /77 V-121 V DC		
	7.	Provision for mechanical closing of the breaker only in "Test" and "WITHDRAWN" positions shall be made. Alternately, the mechanical closing facility shall be normally made inaccessible; accessibility being rendered only after deliberate removal of shrouds.		
	8.	It shall not be possible to open the ACB panel door in breaker closed condition. Further, the racking mechanism shall be accessible only after opening the breaker panel door.		
	Note: The circuit breakers for DC applications shall have manually operated mechanism of spring charged, stored energy type. The closing operation of the circuit breaker shall charge			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 17 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
11.00.00	the tripping spring. Necessary interlocks shall be provided to inhibit closing of the circuit breaker unless the closing spring is fully charged. TELESCOPIC TROLLEY Telescopic trolley or suitable arrangement shall be provided for maintenance of circuit-breaker module in a cubicle. The trolley shall be such that the top most breaker module can be withdrawn on the trolley and can be lowered for maintenance purpose. The telescopic trolley shall be such that all type, size and rating of breaker can be withdrawn /inserted of particular switchgear. The quantity of telescopic trolleys to be supplied shall be 2 Nos. per switchgear room.			
12.00.00	AIR BREAK SWITCHES			
12.01.00	Air break switches shall be of heavy duty, single throw, group operated, load break, fault make type when associated with fuses. All switches for motor circuits shall be of utilization category AC-23A with 1NO +1NC auxiliary contact, which shall be wired to the control circuit as shown in the schematic drawings. All switches for other outgoing feeders shall be of utilization category AC-22A. All switches for DC circuits shall be suitable for 240 V DC and shall be of DC-22 utilization category.			
12.02.00	Continuous current rating of the switches shall be selected from the 'Module Selection tables' for various feeders.			
12.03.00	The combination of switch-fuse unit would be preferred. However, if separate switch and fuses are provided, switch shall be located before fuses.			
12.04.00	The main switches shall be operable from outside the module door. The switch handle shall clearly indicate the position of switch. Switch operating handles shall be provided with padlocking facilities. However, incomer switches of switchboards shall be provided with padlocking facility in both 'ON' and 'OFF' positions.			
12.05.00	Interlocks shall be provided such that the cubicle door will not open when the switch is in closed position and the switch will close only when the door is closed.			
12.06.00	Switches and fuses for AC/DC control supply and heater supply wherever required, shall be mounted inside the cubicles. Toggle switch is not acceptable.			
12.07.00	Even if a single phase feeder is required for certain applications, Contractor shall provide TPN switch, fuse-bases and cable/ link connections between switch/fuse and vertical busbars for all the three phases, so that changing from single phase feeder to three phase feeder is possible without any modification other than inserting fuses at site.			
13.00.00	MCCB			
13.01.00	MCCB shall be fixed type / part of withdrawable feeder module as per specification, three pole, air break type having trip free mechanism with quick make and quick break type contacts. MCCB shall have current limiting feature. MCCB of identical ratings shall be physically and electrically interchangeable. MCCB shall be provided with 1 NO and 1NC auxiliary contacts.			
13.02.00	MCCB shall be provided with Microprocessor based inbuilt front adjustable releases (Overload & Short-circuit) and shall have adjustable Earth Fault protection unit also. The protection settings shall have suitable range to achieve the required time & current settings. LED indications shall also be provided for faults, MCCB status (on/off etc.).			
13.03.00	MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit rating. Extended cable terminal arrangement for higher size cable may also be offered. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB to prevent opening			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 18 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS									
	of the door unless the MCCB is in OFF position. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked. The MCCBs being offered shall have common / interchangeable accessories for all ratings like aux. switch, shunt trip, alarm switch etc. The MCCBs shall have the current discrimination up to full short circuit capacity and shall be selected as per manufacturer's discrimination table.									
13.04.00	Auxiliary contacts of the MCCBs pertaining to critical feeders, to be decided during detailed engineering, shall be connected to the digital inputs available in the numerical relays of Incomer / Bus-coupler / Outgoing circuit breaker feeders, for integration into the numerical relay network.									
14.00.00	CONTROL AND SELECTOR SWITCHES									
14.01.00	Control and selector switches shall be of heavy duty, rotary type with escutcheon plates clearly marked to show the positions. The control & selector switches should be as per IS/IEC 60947 Part V section 1. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred.									
14.02.00	Ammeter and voltmeter selector switches shall have four stay put positions with adequate number of contacts for 3-phase 4-wire system. These shall have oval handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondary.									
14.03.00	Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.									
14.04.00	The contact ratings shall be at least the following : <table><tr><td>1.</td><td>Make and carry, continuously, 10 A at 240 V DC and 110 V AC</td></tr><tr><td>2.</td><td>Breaking current at 240 V DC, 1 A (inductive)</td></tr><tr><td>3.</td><td>Breaking current at 110 V AC and 0.3 lagging p.f., 5A</td></tr></table>				1.	Make and carry, continuously, 10 A at 240 V DC and 110 V AC	2.	Breaking current at 240 V DC, 1 A (inductive)	3.	Breaking current at 110 V AC and 0.3 lagging p.f., 5A
1.	Make and carry, continuously, 10 A at 240 V DC and 110 V AC									
2.	Breaking current at 240 V DC, 1 A (inductive)									
3.	Breaking current at 110 V AC and 0.3 lagging p.f., 5A									
15.00.00	CONTACTORS									
15.01.00	Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty as per IS/IEC 60947 Part-4 Section- 1.									
15.02.00	Contactors shall be double-break, non-gravity type and their main contacts shall be silver faced.									
15.03.00	Direct-on-line contactors shall be of utilization category AC3. Reversing starters shall comprise of Forward and Reverse contactors mechanically and electrically interlocked with each other. These contactors shall be of utilization category AC4. DC contactors shall be of DC3 utilization category. For CHP conveyor motors, minimum rating of power contactors shall be 240% of full load current of the motors. For other CHP drives, minimum rating of power contactors shall be 160% of full load current of motor.									
15.04.00	The number of normally open (NO) and normally closed (NC) auxiliary contacts of a contactor shall be as per requirement shown in the respective module drawings. It shall, however, be not less than 2NO+2NC.									
15.05.00	Operating coil of contactors shall be of 110 V AC unless otherwise specified elsewhere. The contactor shall operate satisfactorily between 85% and 110% of the rated voltage. The contactor shall not drop out at 70% of the rated voltage but shall definitely drop out at 20% of the rated voltage.									
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 19 OF 58						

CLAUSE NO.	TECHNICAL REQUIREMENTS			
15.06.00	Contactors for DC drives shall have a coil voltage of 240 V DC. DC operated contactor coil shall have an economy resistor and shall be suitable for satisfactory continuous operation at 187-242 V DC/ 93.5-121 V			
16.00.00	FUSES			
16.01.00	All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC circuits shall be rated for 80kA rms (prospective) breaking capacity at 415V AC and for DC circuits, 20kA rms breaking capacity at 240V DC.			
16.02.00	Fuse shall have visible operation indicators. Insulating barriers shall be provided between individual power fuses.			
16.03.00	Fuse shall be mounted on insulated fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchboard.			
16.04.00	Fuse ratings shall be selected by the Contractor from the 'Module Selection Tables' for various feeder ratings. However, the fuse ratings for motor feeders given in the 'Motor Module Selection Table' are indicative only, and the same shall be coordinated by the Contractor to achieve class-II protection coordination and also to match the motor characteristics. Switch rating shall in no case be less than the fuse rating.			
16.05.00	The Neutral links shall be mounted on fuse carriers which shall be mounted on fuse bases.			
17.00.00	Instrument Transformers			
17.01.00	All current and voltage transformers shall be of cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the specified ambient temperature. The class of insulation shall be 'E' or better.			
17.02.00	Alternatively, current transformers with unbreakable, flame retardant, self-extinguishing Nylon casing of UL94 grade are also acceptable.			
17.03.00	All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum RMS short circuit breaking and peak making current ratings of the associated switchgear.			
17.04.00	All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block where star point formation and earthing shall be done.			
17.05.00	Current transformers may be multi or single-core type. All voltage transformers shall be single phase type.			
17.06.00	The bus VTs shall be housed in a separate compartment. All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides.			
17.07.00	All CTs shall be provided with supports independent of busbar / busbar supports.			
17.08.00	The CTs shall be located in such a way that they can be easily approached for maintenance without necessitating shut down of adjacent feeders.			
18.00.00	Numerical relays & networking			
18.01.00	All circuit breaker feeders shall be provided with communicable numerical relays complying with IEC-61850, having protection, control, measurement and monitoring features. These relays shall be connected to the Switchgear SCADA System, through Ethernet switches. The relays shall be flush mounted on panel front with connections from the inside. These			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 20 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	numerical relays shall be of types as proven for the application and shall be subject to Employer's approval. Numerical relays shall have appropriate setting ranges, accuracy, resetting ratio and other characteristics to provide required sensitivity. All equipment shall have necessary protections as detailed in the standard scheme drawings / module type descriptions.			
18.02.00	Control of circuit breakers shall be carried out from DDCMIS through hardwired control commands in the form of 24V DC signal. Preferably, binary input of all relays shall be configurable to accept 24V DC signals directly from DDCMIS and no separate coupling relays shall be provided. The Local control console of the relay flush mounted on the switchgear would normally be used only for testing of circuit breaker in isolated position, and for tripping it in an emergency. Provision for closing & tripping of the circuit breaker locally from laptop through serial port shall be possible to facilitate commissioning activities. The basic control scheme of breaker feeders shall be developed using the programmable (soft) logics in the relay.			
18.03.00	Each numerical relay shall be connected to the Ethernet switch(in Employers's scope) provided in the Switchgear through Cat5e Ethernet /FO cable. Ethernet Switches shall be connected through Fibre Optic cable to form a ring network.			
18.04.00	The numerical relay shall be capable of measuring and storing values of a wide range of quantities, events, faults and disturbance recordings. The alarm / status of each of protection function and trip operation shall be communicated to Switchgear SCADA / DDCMIS. The numerical relays shall have built in feature / hardware interface to provide such inputs to Switchgear SCADA / DDCMIS for analog / digital values.			
18.05.00	The required .ICD / .CID files of the Numerical relays under the scope of this package for the integration with the SCADA shall be provided by the Numerical relay vendor along with necessary engineering support.			
18.06.00	All relays shall be rated for control supply voltage as mentioned elsewhere under parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Contacts for breaker close and trip commands shall be so rated as to be used directly used in the closing and tripping circuits of breaker without the need of any interposing / master trip relays. Threshold voltage for binary inputs shall be suitably selected to ensure avoidance of mal operation due to stray voltages and typically shall be more than 70% of the rated control supply voltage.			
18.07.00	One minute power frequency withstand test voltage for all numerical relays shall at least be 2kV (rms).			
18.08.00	Failure of a control supply and de-energization of a relay shall not initiate any circuit breaker operation.			
18.09.00	Disturbance Record waveforms, event records & alarms shall be stored in Non-volatile memory and failure of control supply shall not result in deletion of any of these data.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 21 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
18.10.00	All IEDs shall have freely programmable optically isolated binary inputs (BI) and potential free binary output (BO) contacts, the quantity of which shall be adequate to realize the associated interlocks / feedbacks. In case the offered IED does not have the required number of I/Os, the same can be achieved through external I/O device of same make complying with the requirement stated elsewhere in this specification.			
18.11.00	All the numerical relays shall have communications on three ports, local front port for communication with laptop and dual ports on IEC 61850 to communicate with the Switchgear SCADA System.			
18.12.00	All the numerical relays shall have adequate processor memory for implementing the programmable scheme logic required for the realization of the protection / control schemes, in addition to the built in protection algorithms.			
18.13.00	All Numerical relays shall have features for electrical measurements including voltage, current, power (active & reactive), frequency, power-factor and energy parameters.			
18.14.00	Relays shall have event recording feature, recording of abnormalities and operating parameters with time stamping.			
18.15.00	Master trip (86) and non-86 trips shall be software configurable to output contacts and no separate master trip relay shall be used.			
18.16.00	All numerical relays shall have provision of both current (CT) and voltage (VT) inputs. Relays shall be suitable for both residually connected neutral CT input as well as CBCT input. Relays shall be suitable for CT secondary current of 1A. Motor relays shall have 4 CT inputs. Relays for Incomers, Bus-couplers & Ties shall have 4 CT inputs. All relays except incomers, ties and bus-couplers shall have 3Nos of VT inputs. Relays used in incomers, ties and bus couplers shall have provision of two sets of voltage inputs (3Nos for bus voltage & 1No. for line voltage) for the purpose of synchronization.			
18.17.00	All CT terminals on the relays shall be of fixed type suitable for connection of ring-type lugs to avoid any hazard due to loose connection leading to CT open-circuit. In no circumstances Plug-in type connectors shall be used for CT / VT connections.			
18.18.00	All numerical relay shall have key pad / keys to allow relay settings from relay front. All hand reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable. Manual resetting shall be possible from remote.			
18.19.00	Relays shall have self-diagnostic feature with self-check for power failure, programmable routines, memory and main CPU failures and a separate output contact for indication of any failure.			
18.20.00	Relays shall have at least two sets or groups of two different sets of adaptable settings. Relays shall have multiple IEC / ANSI programmable characteristics.			
18.21.00	Design of the relay must be immune to any kind of electromagnetic interference. Vendor shall submit all related type test reports for the offered model along with the offer.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS
PAGE 22 OF 58				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
18.22.00	All cards / hardware of numerical relays shall be suitable for operation in Harsh Environmental conditions with respect to high temperature, humidity & dust.			
18.23.00	Relay shall be immune to capacitance effect due to long length of connected control cables. Any external hardware, if required for avoiding mal operation of the relay due to cable capacitance shall be included as a standard feature.			
18.24.00	All I/Os shall have galvanic isolation. Analog inputs shall be protected against switching surges, harmonics etc.			
18.25.00	Numerical relays shall have two level password protections, one for read only and other for authorization for modifying the setting etc.			
18.26.00	Numerical relays shall have feature for Time synchronization through the Switchgear SCADA System. The resolution of time synchronization shall be +/- 1.0 millisecond or better throughout the entire system.			
18.27.00	Relays & Ethernet switches shall be suitable to accept both AC & DC supplies with range 110V or 220V with tolerance of 70 % to 120 % of rated voltage & shall be finalized during detailed engineering.			
19.00.00	Other Protections and Control functions in the Relays			
19.01.00	Trip circuit supervision shall be provided for all feeders to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions.			
19.02.00	Schematics requiring auxiliary relays / timers for protection function shall be a part of numerical relay. The number of auxiliary relay and timer function for protection function shall be as required. Timer functions shall be programmable for on/off delays.			
19.03.00	Bus no volt condition shall be configured to an output contact of the relay of incomers for suitably interfacing with DDCMIS wherever required.			
19.04.00	The numerical relay shall be able to provide supervisory functions such as trip circuit monitoring, circuit breaker state monitoring, VT and CT supervisions and recording facilities with post fault analysis.			
19.05.00	The numerical processor shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery backup for real time clock in the event of power supply failure shall be provided.			
19.06.00	At least 200 time tagged events / records shall be stored with time stamping. Details of at least 5 previous faults including the type of protection operated, operating time, all currents & voltages and time of fault.			
19.07.00	Diagnostics Automatic testing, power on diagnostics with continuous monitoring to ensure high degree of reliability shall be shall be provided. The results of the self-reset functions shall be stored in battery back memory. Test features such as examination of input quantities, status of digital inputs and relay outputs shall be shall be available on the user interface.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 23 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
19.08.00	The alarm/status of each individual protection function and trip operation shall be communicated to Switchgear SCADA / DDCMIS.			
19.09.00	Sequence of events shall have 1ms resolution at device level.			
19.10.00	Measurement accuracy shall be 1 % for RMS Current and voltage.			
19.11.00	It shall be possible to carryout open / close operation of breakers from a laptop by interfacing from the relay front port during initial commissioning.			
19.12.00	Required No. of extra binary inputs shall be provided in the numerical relay for digital inputs from critical outgoing MCCB feeders on that switchgear section.			
19.13.00	Circuit-breaker status, protection status, etc. required for control logics shall be hardwired to DDCMIS. In addition, any other requirement of digital & analog signals for process controls shall be taken care of.			
19.14.00	TRAINING			
19.14.01	The contractor shall arrange for training on design, engineering, Commissioning and operation & maintenance of LV Switchgear, Numerical relays and Switchgear networking system for a duration of one (1) man-months.			
19.14.02	The scope shall include training for a batch of engineers and a separate batch of Supervisors/Technicians at Project Site. One such Workshop shall be organized before the commissioning of First LV Switchboard and the second workshop shall be conducted before final system Commissioning. Owner shall provide the required Infrastructure such as Training Conference room, Projection systems etc.			
20.00.00	INDICATING INSTRUMENTS			
20.01.00	All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96mm square size with 90 degree linear scale and shall have an accuracy class of 1.0 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.			
20.02.00	All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment without removing or dismantling the instruments.			
20.03.00	All instruments shall have white dials with black numerals & lettering. Black knife edge pointer shall be provided for meters.			
20.04.00	Ammeters provided for motor feeders (for motors of rating ≥ 30kW & < 100kW) shall have a compressed scale at the upper current region to cover the starting current up to 6.0 times the CT primary current.			
20.05.00	All motor feeders of rating ≥ 30 kW and < 110 kW shall be provided with Multifunction Digital Energy Meter with communication facility to display the current, voltage, power factor, power energy related data locally as well as communicate these for remote metering/audit/analysis purposes. These meters shall The technical specification for Digital indicating energy meter shall be as follows:			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 24 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
	a) Input Voltage:110VAC / 240VDC b) Input Current:1A c) Size:96X96 SQ.MM d) Power & Energy Accuracy: 1.0 e) Mounting: Flush mounting f) Type: True RMS 3-PHASE V,I, kW,PF & kWH indication g) 4 Digit, seven segment LED display/LCD display, with floating decimal h) Communication: In built RS 485 bus port i) Operating Frequency: 45 HZ-65HZ j) Dielectric Test: 2KV RMS for 1 minute k) Over Current: 10 times for 3 sec. l) Aux supply: 90V-300V AC/DC m) Compliance: EMC/EMI n) Field programmable CT ratio o) Analog Current Output (4-20 mA)			
21.00.00	PUSH BUTTONS			
21.01.00	Push-buttons shall be of spring return, push-to-actuate type. Their contacts shall be rated to make, continuously carry and break 10 A at 110 V AC and 1 A (inductive) at 240 V DC.			
21.02.00	All push buttons shall have two (2) normally open and two (2) normally closed contact, unless specified otherwise. The contact faces shall be of silver alloy.			
21.03.00	All push-buttons shall be provided with integral escutcheon plates marked with its function.			
21.04.00	The colour of the button shall as follows : Green for motor START, breaker CLOSE , valve/ damper OPEN commands. Red for motor trip, breaker open, valve / damper close commands. Black for all annunciation functions, overload reset and miscellaneous commands including reverse for clinker grinder etc.			
21.05.00	All push buttons on panels shall be located in such a way that Red push button shall always be to the left of Green push button. In case of clinker grinder etc. the push buttons would be black - red-green from left to right.			
21.06.00	All emergency push buttons shall have mushroom knobs.			
22.00.00	Indicating Lamps			
22.01.00	Indicating lamps shall be of CLUSTER LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 25 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
22.02.00	Lamps shall have translucent lamp-covers of the following colours, as warranted by the application : Red for motor ON, valve / damper OPEN, breaker CLOSE. Green for motor OFF , valve / damper CLOSE, breaker OPEN. White for motor AUTO TRIP. Blue for all healthy conditions (e.g. control supply, and also for SPRING CHARGED"). Amber for all Alarm Conditions (e.g. overload). Also for "SERVICE" and "TEST" position indications.			
22.03.00	Bulbs and lamp covers shall be easily replaceable from the front of the cubicle. The method of mounting indicating lamp fittings on panels shall prevent their rotation under the action of lamp removal or replacements, reliance upon the tightness of ring nut for the purpose is not sufficient.			
22.04.00	Indicating lamps should be located just above the associated push-button / control switches. Red lamps shall invariably be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along the centre line of control switch / push button pair. Blue and Amber should normally be located above the Red and Green lamps.			
22.05.00	When associated with push-buttons, red lamps shall be directly above the green push-button and green lamp shall be directly above the red push button.			
22.06.00	All indicating lamps shall be suitable for continuous operation at 90% to 110% of their rated voltage.			
23.00.00	Space Heater			
23.01.00	Space heaters shall be provided in the switchboards wherever the manufacturer considers them necessary and recommends their provision for preventing harmful moisture condensation.			
23.02.00	The space heaters shall be suitable for continuous operation on 240 V AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary switches and fuses shall be provided.			
23.03.00	The circuit for each panel and motor space heater should have an isolating switch, HRC fuse and isolating link. In addition, the space heater circuit of each panel shall also have a thermostat of suitable rating.			
24.00.00	INTERNAL WIRING			
24.01.00	All switchboards shall be supplied completely wired internally upto the terminals, ready to receive external cables.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 26 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
24.02.00	All inter-cubicle and inter-panel wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided by the Contractor.			
24.03.00	All auxiliary wiring shall be carried out with 650V grade, single core stranded Copper conductor, colour coded, PVC insulated wires. Conductor size shall be 1.5 mm ² (min.) for control circuit wiring and 2.5 mm ² (min) for CT and space heater circuits.			
24.04.00	Extra flexible wires shall be used for wiring to devices mounted on moving parts such as hinged doors. The wire bunches from the panel inside to the doors shall be properly sleeved or taped.			
24.05.00	All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.			
24.06.00	All internal wiring terminations shall be made with solderless crimping type tinned Copper lugs which shall firmly grip the conductor or an equally secure method. Similar lugs shall also be provided at both ends of component to component wiring. Insulating sleeves shall be provided over the exposed parts of lugs to the extent possible. Screw-less (spring loaded) / cage clamp type terminal shall also be provided with lugs.			
24.07.00	Printed single tube ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The wire identification marking shall be in accordance with IS: 375. Red Ferrules should be provided on trip circuit wiring.			
24.08.00	Wiring for equipment, which are to be supplied by the Contractor and for which the Contractor has to provide mounting arrangement in his panels, shall also be provided by the Contractor, up to the terminal blocks.			
24.09.00	All connections from vertical busbars for individual modules above 100 A shall be by Copper / Aluminium links only. The cable connections for modules less than 100 A shall be selected in such a way that there will not be any melting / shorting in case of a short circuit inside the module and the cable shall have current rating to carry the let through energy of the corresponding fuses in case of a fault. The insulation of the cable and its cross section shall be decided considering the high ambient temperature within the module. For all modules where use of cable is envisaged by the Contractor specific approval from the Employer regarding cable details are to be taken. For power wiring colour coded wire insulation / tapes shall be provided.			
25.00.00	CONTROL TERMINAL BLOCKS			
25.01.00	Terminal blocks shall be 650V grade, 10Amps rated, made up of unbreakable polyamide 6.6 grade. The terminals shall be either 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.			
25.02.00	Terminal blocks for CT and VT secondary leads shall be of stud type, made up of unbreakable polyamide 6.6 grade. They shall be provided with links to facilitate testing, isolation star / delta formation and earthing. Terminal blocks for CT secondary shall have the short circuiting facility. The terminals for remote ammeter connection etc. shall also be			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS
PAGE 27 OF 58				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	disconnecting type only. All metal parts shall be of non-ferrous material. Screws shall be captive.			
25.03.00	In all circuit breaker panels MCC modules at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks.			
25.04.00	All terminal blocks shall be suitable for terminating on each side two (2) nos. stranded Copper conductors of size up to 2.5 sq. mm each, or alternatively, the terminal blocks shall have the possibility of double shorting space to facilitate looping. However for DDCMIS terminals shall be suitable for 1.5 mm² cable.			
25.05.00	All terminals shall be numbered for identification and grouped according to the function. Engraved white-in-black labels shall be provided on the terminal blocks.			
25.06.00	Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.			
25.07.00	Terminal blocks shall be arranged with at least 100mm clearance between two sets of terminal blocks. The minimum clearance between the first row of terminal blocks and the associated cable gland plate shall be 250 mm.			
26.00.00	Power Cable Termination			
26.01.00	Cable termination compartment and arrangement for power cables shall be suitable for heavy duty, 1.1 kV grade, stranded Aluminium conductor, PVC/ XLPE insulated, armored / unarmored and PVC sheathed cables. The size and type of cable for individual modules shall, preferably, be as indicated in the 'Module Selection Tables'. All necessary cable terminating accessories such as supporting clamps and brackets, hardware etc. for cables shall be provided by the contractor to suit the final cable sizes.			
26.02.00	All power cable terminals shall be of stud type and the power cable lugs shall be of tinned Copper solderless crimping ring type conforming to IS: 8309. All lugs shall be insulated/ sleeved.			
27.00.00	LOCAL PUSH BUTTON STATIONS			
27.01.00	The enclosure shall be provided with a hinged guard at the front, covering full length, to avoid inadvertent operation of push buttons Support structure for mounting the LPBS shall also be supplied by Contractor. The local push button stations shall be dust and vermin proof and shall have a degree of protection of IP -55 as per IS/IEC 60947. The DOP shall be IP-65 in case the same are located in dusty areas.			
27.02.00	The local push button stations shall be metal enclosed, suitable for outdoor / indoor mounting on wall or steel structures. The enclosure shall be die-cast Aluminium or cold-rolled sheet steel of at least 1.6 mm thickness. LPBS shall be painted to shade no. RAL: 9002.			
27.03.00	Local push button stations enclosure made of FRP (Fiberglass Reinforced Polymer) may also be offered. The FRP enclosure shall be of SMC Hot press Moulded, Halogen free and flame retardant as per UL94, V-0. The thickness of the FRP enclosure shall be at least 4mm.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 28 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	The colour of the FRP type LPBS shall be of RAL 7035 and the hinges, nuts & bolts shall be of Polyamide / Stainless Steel material.			
27.04.00	The push button stations shall be suitable for bottom cable entry and shall be provided with removable undrilled gland plates or knockouts to facilitate termination of two numbers of control cables. Adequate space shall be available inside the push button station enclosure for terminating external cables directly on pushbutton terminals. Overall size of push button stations shall be subject to Employer's approval.			
27.05.00	The push button station shall comprise of a latched type EMERGENCY STOP push button with two (2) NO and two (2) NC contacts.			
27.06.00	Support structure for mounting in local push button stations shall be supplied by the Contractor.			
28.00.00	LOCAL MOTOR STARTERS			
28.01.00	Local motor starters shall be suitable for manual switching of 415 V, 3-phase, squirrel cage motors rated up to 5.5 kW. They shall have constructional features similar to those specified for local push button stations.			
28.02.00	Each starter shall comprise of :			
	1.	A 3-pole contactor, mechanically latched type.		
	2.	Start push button, coloured green.		
	3.	Stop push button, coloured red.		
	4.	Ambient temperature compensated, thermal over load relay with single phasing protection. The continuously variable relay setting range shall be suitable for the motor rating which shall be advised to the Contractor in due course. The relay shall trip the contactor.		
28.03.00	The start push button, when pressed, shall preferably remain in depressed position and shall be released along with the contactor when the stop push button is pressed or when thermal overload relay operates.			
28.04.00	Local starters shall be suitable for loop-in and loop-out of incoming cable and for one outgoing cable to motor. Support structure for mounting in local motor starters shall be supplied by the Contractor.			
29.00.00	Name Plates and Labels			
29.01.00	All Switchgears, MCCs, Distribution Boards, Fuse boards, all feeders, local push-button stations and local motor starters shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear switchgear also.			
29.02.00	All name plates shall be of non-rusting metal or 3-ply Lamicoid, with white engraved lettering on black background. Letter size shall be of at least 10mm height.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 29 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
29.03.00	Suitable stenciled paint mark shall be provided inside the panel/module for identification of all equipment in addition to the plastic sticker labels, if provided. These labels shall be positioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring drawings.			
29.04.00	Caution name plate "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end.			
30.00.00	METAL ENCLOSED NON SEGREGATED PHASE BUSDUCT(AIR INSULATED)			
30.01.00	Three phase and neutral metal enclosed non segregated phase busduct assemblies shall be supplied for incoming connections from the transformers to the switch boards and inter connecting sections between switch boards, wherever applicable. The rating of the incoming and interconnecting busducts shall be same as the rating of the switchboard.			
30.02.00	The enclosure shall be made of minimum 3 mm thick Aluminium alloy. The section of the busduct shall be rectangular. The design of the busduct enclosures shall be of sturdy construction such that it will withstand the internal or external forces resulting from the various operating conditions.			
30.03.00	The entire busduct shall be designed for dust, vermin and weather proof construction. A suitable Aluminium sheet flange-protection hood shall be provided to cover all outdoor busduct enclosure joints to facilitate additional protection against rain water ingress. All horizontal runs of busducts shall have a suitable sloped enclosure top to prevent retention of water for both indoor and outdoor portion of busducts. Busduct enclosure shall have a degree of protection of IP-55.			
30.04.00	The inside of the bus enclosure may be treated with black paint to enable efficient heat dissipation. The matt paint used shall be suitable for temperature experienced during continuous loading of the bus conductor. The busduct exterior paint shade shall be RAL 5012.			
30.05.00	Flexible expansion joints for the enclosure shall be provided wherever deemed necessary by the Contractor. Necessary bonding shall be provided at the expansion joints if made of insulating materials.			
30.06.00	Enclosures shall be provided with flanged ends with drilling dimensions to suit the flanges at the switchgear and transformer terminals. Any adapter boxes required for this purpose are in the Contractor's scope of supply. The flanges shall be provided with gaskets, nuts, bolts, etc. Details of the flanges provided on transformer ends will be furnished to the successful Contractor.			
30.07.00	Suitable Inspection covers shall be provided for periodic inspection of insulators. Handle shall be provided on each inspection cover to facilitate easy lifting.			
30.08.00	The EPDM / Neoprene gaskets shall be provided so as to satisfy the operating conditions imposed by temperature, weathering, durability etc. Flange gaskets shall be provided at the equipment terminal connections.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS
PAGE 30 OF 58				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
30.09.00	Necessary earthing arrangement as applicable shall be provided with clamps to receive station earthing bus. All accessories and hardware required for the earthing arrangement shall be provided by the Contractor. This shall be a GI strip of adequate size, continuously running along the busduct and shall be earthed at both ends. Busduct enclosures shall be bolted type.			
30.10.00	The material of the conductor shall be Aluminium. The minimum clearance in air between phase to phase, phase to neutral and phase to earth for the entire run of busduct shall be 25 mm The bus bars shall be rated in accordance with the service conditions and the rated continuous and short time current ratings calculated for specific application / specified elsewhere.			
30.11.00	All steel structures required for busduct support shall be hot dip galvanized.			
30.12.00	Space heaters shall be provided in the busduct wherever the manufacturer considers them necessary and recommends their provision for preventing harmful moisture condensation.			
30.13.00	The space heaters shall be suitable for continuous operation on 240 V AC, 50 Hz single phase supply and shall be automatically controlled by thermostats. Necessary wiring upto junction boxes mounted on busduct and from junction boxes to switch boards shall be provided by the Contractor.			
31.00.00	BUS TRUNKING SYSTEM (SANDWICH TYPE BUSDUCT)			
31.01.00	Three phase Bus trunking system conforming to IEC 61439-6 / IS 8623 (Parts 1 & 2) shall be provided for connecting the Main and Standby DG sets to Unit Emergency Switchgears.			
31.02.00	The enclosure shall be made of CRCA (1.6mm thick) / GI (1.6mm thick) / Aluminium (2.5mm thick) sheet. The design of the bus duct enclosure shall be of sturdy construction such that it will withstand the internal or external forces resulting from the various operating conditions.			
31.03.00	The entire bus duct shall be designed for dust, vermin and weather proof construction. A suitable aluminium sheet flange-protection hood shall be provided to cover all outdoor bus duct enclosure joints to facilitate additional protection against rain water ingress. All horizontal runs of bus ducts shall have a suitable sloped enclosure top to prevent retention of water for both indoor and out door portion of busducts. Busduct enclosure shall have a degree of protection of IP-55.			
31.04.00	The busduct exterior paint shade shall be RAL 5012.			
31.05.00	Enclosures shall be provided with flanged ends with drilling dimensions to suit the flanges at the switchgear and DG terminals. Any adapter boxes required for this purpose are in the contractor's scope of supply. The flanges shall be provided with gaskets, nuts, bolts, etc.			
31.06.00	EPDM / Neoprene gaskets shall be provided so as to satisfy the operating conditions imposed by temperature, weathering, durability etc. Flange gaskets shall be provided at the equipment terminal connections.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS
PAGE 31 OF 58				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
31.07.00	Necessary earthing arrangement as applicable shall be provided with clamps to receive station earthing bus. All accessories and hardware required for the earthing arrangement shall be provided by the contractor. This shall be a GI strip of adequate size, continuously running along the busduct and shall be earthed at both ends. busduct enclosures shall be bolted type.			
31.08.00	The material of the conductor shall be high conductivity aluminum / copper. The busbars shall be rated in accordance with the service conditions and the rated continuous and short time current ratings specified elsewhere.			
31.09.00	All steel structures required for busduct support shall be hot dip galvanized.			
31.10.00	Space heaters shall be provided in the busduct wherever the manufacturer considers them necessary and recommends their provision for preventing harmful moisture condensation.			
31.11.00	The space heaters shall be suitable for continuous operation on 240 V AC, 50 Hz single phase supply and shall be automatically controlled by thermostats. Necessary wiring upto junction boxes mounted on busduct and from junction boxes to switch boards shall be provided by the contractor.			
32.00.00	LIGHTING / WELDING TRANSFORMERS Each AC Lighting Distribution Board (LDB) shall be fed from 415V / 415V, 50kVA(minimum) isolating transformer & Each Welding Distribution Board (LDB) shall be fed from 415V / 415V, 100kVA isolating transformer. The lighting / welding transformer may, preferably, be located inside the LDB / Welding DB panel itself. Otherwise, the same shall be located by the side of respective LDB / Welding DB. Lighting / Welding transformers shall be dry type, natural air cooled with class B insulation or better. Impedance of lighting / Welding transformer shall be so selected that the fault level of lighting /Welding system shall be reduced to 3 to 5 KA. Lighting / Welding transformers shall be tested as per IS: 2026. Off-circuit tap changer with ± 2.5% and ± 5% tapping shall be provided. In case the transformers are not mounted inside the LDB panels, the same shall be housed in a separate 2 mm thick CR sheet steel enclosure with IP-42 degree of protection as per IS/IEC 60947. However, the transformer terminal box shall have IP-52 degree of protection.			
33.00.00	PAINTING All sheet steel work shall be pre-treated, in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "Class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, Electrostatic Powder Coating shall be used. Powder should meet requirements of IS 13871 (Powder costing specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the Employer. The paint thickness shall not be less than 50 microns. Finished parts shall be suitably packed and wrapped with protective covering to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 32 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
34.00.00	GASKETS The gaskets, wherever specified, shall be of good quality EPDM / Neoprene with good ageing, compression and oil resistance characteristics suitable for panel applications.			
35.00.00	TEMPERATURE –RISE The temperature rise of the horizontal and vertical busbars and main bus links including all power draw-out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 ⁰ C with silver plated joints and 40 ⁰ C with all other types of joints over an outside ambient temperature of 50 ⁰ C. The temperature rise of the accessible parts/external enclosures expected to be touched in normal operation shall not exceed 20 ⁰ C. The temperature rise of manual operating means shall not exceed 10 ⁰ C for metallic & 15 ⁰ C for insulating material. Temperature rise for the busbars shall be carried out at 90% of the rated current. The above temperature rise limits are applicable for busducts also without any current derating.			
36.00.00	DERATING OF EQUIPMENTS The Contractor shall ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per Indian Standards / Specification. Continuous current rating at 50 ⁰ C ambient in no case shall be less than 90% of the normal rating specified. The Contractor shall indicate clearly the derating factors if any employed for each component and furnish the basis for arriving at these derating factors duly considering the specified current ratings and ambient temperature of 50 ⁰ C.			
37.00.00	PROTECTION CO-ORDINATION It shall be the responsibility of the Contractor to fully coordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers / fuses / motor starters, to provide satisfactory discrimination. Further the various equipment supplied shall meet the requirements of Type 2 class of Co-ordination as per IS: 8544.			
38.00.00	TESTS AND TEST REPORTS			
38.01.00	GENERAL (a.) All equipment to be supplied shall be of type tested design. The Contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to 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. (b.) In case the Contractor is not able to submit report of the type test(s) conducted not earlier than ten years prior to 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 at no additional cost either at third party lab or in presence of client/Employer's representative and submit the reports for approval. (c.) All routine tests as per the specification and relevant standards shall be carried out.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 33 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
38.02.00	The following type test certificates of LT Switchgear and MCC panels shall be submitted.			
	1)	Circuit breaker of each rating		
	a)	Test sequence 1		
	b)	Combined test sequence (With Circuit breakers mounted inside the Switchgear panel)		
	2)	Complete design verification of Switchgear/MCC Panels as per IEC 61439 Part-1, Annexure-D		
	3)	Internal arc test for Personnel and Assembly Protection as per IEC/TR 61641		
	4)	MCC modules of any three ratings, as selected by the Employer, for class - II protection Co-ordination.		
	5)	Test for single phasing protection feature on 3 nos. bimetallic thermal overload relay selected by Employer. The relay shall be tested for compliance with manufacturer's printed / declared characteristic curve.		
38.03.00	For the following equipment the contractor shall submit the reports of all the type tests as per applicable standards and carried out not earlier than ten years prior to 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 at no additional cost to the Employer either at third party lab or in presence of client/Employer's representative and submit the reports for approval.			
	(a.) NUMERICAL RELAYS			
	(b.) LOCAL PUSH BUTTON STATION			
	(c.) LOCAL MOTOR STARTER			
	(d.) MCCB			
38.04.00	Type test reports for the following tests on the model of the Numerical relays, Ethernet switches shall be submitted for Employer's review.			
	S. No.	TEST ITEMS	Standard	
	1	Dimensions of structure and visual inspection	IEC 60297-3-101	
	2	Functional requirements:	Relevant	
		– Steady-state simulation	IEC 60255-100	
		– Dynamic simulation	series	
	3	Product safety requirements	IEC 60255-27	
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS
PAGE 34 OF 58				

CLAUSE NO.	TECHNICAL REQUIREMENTS				
		(including the dielectric tests and thermal short time rating)			
	4	EMC requirements:		IEC 60255-26	
		– Emission			
		– Immunity			
	5	Energizing quantities:			
		– Burden		N/A	
		– Change of auxiliary energizing quantity		IEC 60255-11	
	6	Contact performance		N/A	
	7	Communication requirements		Relevant IEC protocol standards	
	8	Climatic environmental requirements:		IEC 60068-2-14,	
		– Cold		IEC 60068-2-1,	
		– Dry heat		IEC 60068-2-2,	
		– Change of temperature		IEC 60068-2-78,	
		– Damp heat		IEC 60068-2-30, IEC 60255-27	
	9	Mechanical requirements: – Shock		IEC 60255-21-1,	
		– Vibration		IEC 60255-21-2,	
		– Bump		IEC 60255-21-3	
		– Seismic			
	10	Enclosure protection		IEC 60529, IEC 60255-27	
	38.05.00	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.			
	38.06.00	All routine tests as per the specification and relevant standard IS 8623 shall be carried out.			
38.07.00	An indicative lists of tests / checks is mentioned as QA chapter. However, the manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.				
38.08.00	All procedures for type tests shall be approved by Employer before commencement of type tests. However, the following points may be specifically noted.				
	1)	For temperature rise tests, the connection arrangement between the source and the test equipment shall be such that the temperature gradient in the connection piece of cable at a distance of one meter away from the test equipment shall be restricted to 5 ⁰ C.			
	2)	Milli-Volt drop test shall be done on switching devices before and after the type tests.			
	3)	Bolt tightness of busbar joints shall be checked with torque wrench before and after short time rating tests on the circuit breaker and MCC panels.			
38.09.00	Routine checking to observe compliance to degree of protection, first numeral, on switchboard enclosures and busbar chambers shall be as under :				
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	
PAGE 35 OF 58					

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	1) IP -4 X	It shall not be possible to insert a one mm dia. Steel wire into the enclosure from any direction, without using force.		
	2) IP-5X	It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.		
39.00.00	ERECTION / INSTALLATION OF SWITCHBOARDS AND OTHER EQUIPMENTS			
39.01.00	Each equipment shall be installed in a neat, workman-like manner so that it is levelled, plumbed, squared and properly aligned and oriented. Tolerances shall be as established in Contractor's drawings or as stipulated by Employer. No equipment shall be permanently fixed down to foundations until the alignment has been checked and found acceptable by the Employer.			
39.02.00	Contractor shall furnish all supervision, labour, tools, equipment, rigging materials, bolts, wedges, anchors, etc., in proper time, required to completely install, test and commission the equipment.			
39.03.00	Manufacturer's and Employer's instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment.			
39.04.00	Contractor shall move all equipment into the respective rooms through the regular door or openings specifically provided for this purpose. No part of the structure shall be utilised to lift or erect any equipment without prior permission of Engineer.			
39.05.00	All switchboards shall be installed in accordance with Indian Standard, IS: 3072, and Employer's instructions.			
39.06.00	Switchboard panels shall be installed on concrete floor or supported on steel channel / edge angle in concrete trenches. The Contractor shall provide steel insert plates in the concrete floor and / or steel channels / edge angle on the trenches as applicable. The base frame of switchboards shall be welded to the insert plates by the Contractor. The Contractor shall be required to install and align the panels using suitable metallic shims before welding the base frame. In joining shipping sections of switchboards together, adjacent housing of panel sections or flanged throat sections shall be bolted together after alignment has been completed.			
39.07.00	Contractor shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments and relays are supplied separately they shall be mounted only after the associated panels have been erected and aligned. the blocking materials employed for safe transit of instruments and relays shall be removed after ensuring that panels have been completely installed and no further movement of the same would be necessary. Any damage shall be immediately reported to Engineer.			
39.08.00	Equipment furnished with finished coats of paint shall be touched up by Contractor if their surface is spoiled or marred during erection / commissioning.			
39.09.00	The room and floor finishing work would be done after erection of the panels and the Contractor shall suitably cover up the panels to protect them from injury and marring of finish.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 36 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
40.00.00	COMMISSIONING CHECKS / TESTS			
40.01.00	After installation of panels, power and control wiring and connections, Contractor shall perform operational tests on all switchboards, to verify proper operation of switchboards / panels and correctness of all equipment in each and every respect.			
40.02.00	The Contractor shall carry out the following commissioning checks, in addition to other checks and tests recommended by the manufacturers.			
40.03.00	GENERAL			
	(a.) Check name plate details according to the approved drawings.			
	(b.) Check for physical damage.			
	(c.) Check tightness of all bolted connections, by torque wrench.			
	(d.) Check earth connections.			
	(e.) Check cleanliness.			
	(f.) Check all moving parts for proper lubrication.			
40.04.00	Circuit Breakers			
	(a.) Check alignment of breaker truck for free movement.			
	(b.) Check correct operation of shutters.			
	(c.) Check control wiring for correctness of connections, continuity And IR values.			
	(d.) Manual operation of breakers completely assembled.			
	(e.) Closing /opening operation, manually and electrically.			
	(f.) Trip free and anti-pumping operation.			
	(g.) I.R. values of contacts.			
	(h.) Contact resistance.			
	(i.) Check on spring charging motor, correct operation of limit switches and time or charging.			
	(j.) All functional checks			
	(k.) Breaker closing and tripping time, if required.			
40.05.00	Current Transformers			
	(a.) Visual inspection.			
	(b.) IR Value			
	(c.) Ratio check.			
	(d.) Magnetising current.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 37 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
41.04.00	One (1) Indicating lamp with resistor and coloured lens suitable for 415 V AC.			
	Three (3) HRC control fuses.			
41.05.00	Reserve Incomer			
	One (1) Triple pole load break isolating switch			
41.04.00	One (1) Triple pole contactor with coil suitable for 415 V AC.			
	One (1) Indicating lamp with resistor and coloured lens suitable for 415 V AC.			
41.05.00	Two (2) HRC control fuses.			
	Module Type CS (AC Control Supply Module)			
41.04.00	(Note: Module type CS will be of non-draw-out type)			
	Two (2) 415/110 V control transformers.			
41.05.00	Four (4) 110V auxiliary relays.			
	Two (2) Earth links.			
41.04.00	Eight (8) HRC Control fuses.			
	Two (2) Selector switches			
41.05.00	Module Type DG (Circuit Breaker Incomer From DG Set)			
	(a.) One (1) Triple-pole circuit breaker, complete with all accessories and power operated mechanism, as specified.			
41.04.00	(b.) Three (3) Current transformers for protection & metering.			
	(c.) One (1) DC isolating Switch			
41.05.00	(d.) Six (6) HRC control fuses			
	(e.) Numerical relay for the following:			
41.04.00	• Differential protection			
	• Over Load protection			
41.05.00	• Reverse Power Protection			
	• DG Neutral displacement			
41.04.00	• Energy Metering			
	• Current and Voltage metering			
41.05.00	• DG Monitoring			

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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 40 OF 58
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
41.06.00	Module Type E/E1/E2 (Switch Fuse Module/MCCB) (a) One (1) Triple pole switch-fuse unit with three pole isolating switch and three / one / two HRC fuses for E/E1/E2 modules, respectively. (b) One (1) Neutral link. (c) One (1) 3 pole MCCB (for rating 100A and above)			
41.07.00	Module Type G1 (VT Module with Under Voltage / No Volt Relay) (a.) Three (3) 415/√3 / 110/√3 V single phase voltage transformers, mounted on a common draw-out chassis (b.) Three (3) HRC fuses for VT primary. (c.) Three (3) HRC control fuses.			
41.08.00	Module Type H (Isolating Switch Module) (a) One (1) Triple pole load break isolating switch (b) One (1) Neutral link			
41.09.00	Module type K1 (Non Reversible Motor Rated Below 30 kW Controlled from MCC) (a) One (1) Triple pole fuse switch unit with three pole load break isolating switch and three HRC fuses. (b) One (1) Triple pole contactor. (c) One (1) Bimetallic thermal overload relay with single phasing preventer. For motor with high starting time, heavy duty overload relay shall be provided. (d) Two (2) Push buttons. (e) Three (3) Indicating lamps with resistors and coloured lenses. (f) One (1) HRC control fuse. (g) One (1) Control link.			
41.10.00	Module Type K11 (Non reversible Motor Rated 30kW to 200kW Controlled from MCC) Similar to module type K1 but with the following additions: One (1) Current transformer for metering. One (1) Ammeter One (1) Single-pole switch and fuse for motor space heater.			
41.11.00	Module type DK2 (Non Reversible Motor rated below 30kW Controlled from DDCMIS) (a) One (1) Triple pole switch fuse unit with three pole load break Isolating switch and three HRC fuses.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 41 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(b)	One (1) Triple pole contactor.	
	(c)	One (1) Bimetallic thermal overload relay with single phasing preventor. Modules marked with * (DK2* / PK2*) shall not have this relay. For motor with high starting time, heavy duty overload relay shall be provided.	
	(d)	Three (3) Indicating lamps with resistors and coloured lenses.	
	(e)	One (1) HRC control fuse.	
	(f)	One (1) Control link	
	(g)	One (1) Auxiliary contactor	
	(h)	Two (2) Coupling relays suitable for 24V DC.	
	(i)	One (1) digital energy meter with analog output of current (4-20 mA) for CHP dust suppression motors.	
41.12.00	Module Type DK21 (Non Reversible Motor rated 30kW to up to 110KW (* See Remark) controlled from DDCMIS). (*) Remark : For CHP Motors –upto 160 KW		
	(a)	Similar to module type DK2 but with the following additions :	
	(b)	Three (3) Current transformers for metering.	
	(c)	One (1) Ammeter (for motors of rating $\geq 30\text{kW}$ & $< 110\text{kW}$)	
	(d)	One (1) Single-pole switch and fuse for motor space heater.	
	(e)	One (1) Digital Energy Meter with Analog output of Current (4-20 mA) (for motors of rating $\geq 30\text{kW}$ & $< 110\text{kW}$)	
41.13.00	Module Type DN1 (Reversible Motor Controlled from DDCMIS)		
	(a.)	One (1) Triple pole fuse switch unit with three pole load break solating switch and three HRC fuses.	
	(b.)	Two (2) Triple pole mechanically interlocked, forward / reverse contactors.	
	(c.)	One (1) Bimetallic thermal overload relay with single phasing preventor.	
	(d.)	One (1) Indicating lamp with resistor and coloured lens.	
	(e.)	One (1) HRC control fuse	
	(f.)	One (1) Control link	
	(g.)	One (1) Auxiliary contactor	
	(h.)	Two (2) Coupling relays suitable for 24V DC.	
41.14.00	Module Type VM (Voltmeter Module)		
	(a.)	Three (3) HRC fuses.	
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS
			PAGE 42 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS			
41.15.00	(b.) One (1) Voltmeter (0-500 V.)			
	(c.) One (1) Four position voltmeter selector switch			
	(d.) One (1) 415 V auxiliary contactor with 2 NO + 2 NC contacts.			
	(e.) One (1) Voltage transducer with output of 4-20mA between R & Y phases			
	Module Type DM (Circuit Breaker (DDC /PLC Controlled) Motor Feeder for motor rated 110 KW & above (except for CHP motors).			
	(a.) One (1) Triple-pole circuit breaker, complete with all accessories and power operated mechanism, as specified.			
	(b.) Three (3) Current transformers for Protection and metering.			
	(c.) One (1) DC isolating Switch			
	(d.) Six (6) HRC Control fuses.			
	(e.) One (1) Single-pole switch and fuse for motor space heater			
42.00.00	(f.) Numerical relay for the following:			
	Short Circuit Protection (50)			
	Thermal Over Load protection(51I)			
	Earth fault Protection(50N)			
	Negative sequence Protection(46)			
	Restart inhibit protection(49)			
	Locked Rotor Protection			
	Energy Metering			
	Current and Voltage metering			
	Trip Circuit Supervision			
42.01.00	CB Monitoring			
	DC MODULES DESCRIPTION			
	Module Type -CH (Incomer)			
	(a) One (1) Double pole, 250 V DC fuse -switch unit			
	Module Type - DC			
	(a.) One (1) Double pole 250V DC switch / circuit breaker with 2NO+2NC auxiliary contacts.			
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 43 OF 58

CLAUSE NO.	TECHNICAL REQUIREMENTS																																															
42.03.00	Module Type - HD (DC Isolating Switch / Circuit - Breaker Module) (a.) One (1) Double pole , 250 V DC switch isolator / circuit breaker																																															
42.04.00	Module Type-S (DC Metering and Protection Module) (a.) One (1) Voltmeter, 0-300V DC (b.) One (1) Three position voltmeter selector switch (c.) One (1) Instantaneous under voltage relay (27) with a setting of 95% of 240V DC. The resetting ratio of relay should not be more than 1.05. (d.) One (1) Instantaneous over voltage relay (59) which shall operate at 110% of 240 V DC. The resetting ratio of relay should not be less than 0.95. (e.) One (1) Earth leakage relay having adjustable pick up range between 3 to 7mA. The relay shall be suitable for 240V / 50V DC and 240V AC auxiliary supply. (f.) Two (2) Indicating lamps with resistors & coloured lenses, one each for 'Earth fault' and 'DC supply failure ' indications. (g.) Three (3) HRC control fuses. (h.) One (1) Neutral link																																															
42.05.00	Module Type -X (DC Isolating Switch Fuse Module) (a.) One (1) Double pole , 250 V DC fuse switch unit with two HRC fuses.																																															
43.00.00	SELECTION TABLES																																															
43.01.00	Feeder Module, Other than Motor Selection Table (415 V AC) <table><tr><th>Sl. No.</th><th>Feeder Rating (Amp.)</th><th>Switch/MCCB Rating (Amp.)</th><th>Fuse Rating (Amp.)</th></tr><tr><td>1.</td><td>0-16</td><td>16</td><td>16</td></tr><tr><td>2.</td><td>17-32</td><td>32</td><td>32</td></tr><tr><td>3.</td><td>33-45</td><td>63</td><td>63</td></tr><tr><td>4.</td><td>46-63</td><td>63</td><td>63</td></tr><tr><td>5.</td><td>64-99</td><td>100</td><td>100</td></tr><tr><td>6.</td><td>100</td><td>100A MCCB</td><td></td></tr><tr><td>7.</td><td>101-160</td><td>160A MCCB</td><td></td></tr><tr><td>8.</td><td>161-250</td><td>250A MCCB</td><td></td></tr><tr><td>9.</td><td>251-400</td><td>400A MCCB</td><td></td></tr><tr><td>10.</td><td>401-1120 (Breaker)</td><td></td><td></td></tr></table>				Sl. No.	Feeder Rating (Amp.)	Switch/MCCB Rating (Amp.)	Fuse Rating (Amp.)	1.	0-16	16	16	2.	17-32	32	32	3.	33-45	63	63	4.	46-63	63	63	5.	64-99	100	100	6.	100	100A MCCB		7.	101-160	160A MCCB		8.	161-250	250A MCCB		9.	251-400	400A MCCB		10.	401-1120 (Breaker)		
Sl. No.	Feeder Rating (Amp.)	Switch/MCCB Rating (Amp.)	Fuse Rating (Amp.)																																													
1.	0-16	16	16																																													
2.	17-32	32	32																																													
3.	33-45	63	63																																													
4.	46-63	63	63																																													
5.	64-99	100	100																																													
6.	100	100A MCCB																																														
7.	101-160	160A MCCB																																														
8.	161-250	250A MCCB																																														
9.	251-400	400A MCCB																																														
10.	401-1120 (Breaker)																																															
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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	PAGE 44 OF 58																																												

CLAUSE NO.	TECHNICAL REQUIREMENTS					
43.02.00	11.	1121-1680 (Breaker)				
	Motor Module Selection table					
	Sl. No.	Motor rating kW	Max. Motor Amp.	Switch rating Amp.	Fuse rating Amp.	Contactor rating Amp.
	1.	1.1-1.5	3.5	16	6/16	16
	2.	1.6-3.0	7	32	20	16
	3.	3.1-5.5	11	32	32	16
	4.	5.6-7.0	14.4	63	50	32
	5.	7.1-13.0	27.3	63	63	32
	6.	13.1-24.0	45	125	80/100	63
	7.	24.1-37.0	70	125	125	70 (upto 30kW) 100 (above 30kW)
43.03.00	8.	37.1-55.0	100	250	160	100 (upto 40kW) 160 (upto 55kW)
	9.	55.1-80.0	150	250	200	200
	10.	80.1-100	180	As per selected fuse	Suitable for type-II	225
	12.	110.0-200.0	CIRCUIT BREAKER			
	Switch Fuse Module Selection Table (220 V DC)					
	For all 220 V DC modules other than for motors, the ratings of switches fuses and cable termination shall be selected from the following table					
	Sl. No.	Feeder rating Amp.	Switch rating Amp.	Fuse rating Amp.		
	1.	0-6	10	6		
	2.	6-10	16	10		
	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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	
				PAGE 45 OF 58		

CLAUSE NO.	TECHNICAL REQUIREMENTS					
44.00.00	3.	10-14	16	16		
	4.	14-19	32	32		
	5.	19-32	32	32		
	6.	32-53	63	63		
	7.	53-81	100	100		
	8.	81-114	125	125		
	9.	114-125	250	250		
	10.	215-340	400	400		
	11.	340-560	600	600		
	12.	560-1000	Circuit Breaker			
	13.	1000-1400	Circuit Breaker			
	COMMISSIONING OF LT SWITCHGEARS					
	Commissioning of LT switchgears at site shall only be carried out either by the switchgear manufacturer himself or under the supervision of the switchgear manufacturer.					
	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 II-E-10 LT SWITCHGEARS & LT BUSDUCTS	
PAGE 46 OF 58						

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LEGEND DESCRIPTION

52	CIRCUIT BREAKER
42	CONTACTOR
S.A.	SURGE ARRESTOR
	CURRENT TRANSFORMER
	CORE BALANCE CURRENT TRANSFORMER
	VOLTAGE TRANSFORMER
50	TRIPLE POLE IDMTL/DMT O/C PROTECTION
51	TRIPLE POLE INSTANTENIOUS O/C PROT.N.
50N	IDMTL / DMT SENSITIVE E/F PROTECTION
51N	INSTANTENIOUS E/F PROTECTION
49	THREE PHASE THERMAL O/L PROT.N. WITH O/L ALARM & RESTART INHIBITE FUNCTION
50L/R	STALLING / LOCKED ROTOR PROTECTION
46	THREE PHASE NEGATIVE PHASE SEQUENCE PROTECTION
66	NUMBER OF START LIMITATION/REPATETIVE START PROTECTION
2	TIME DELAY RELAY
60	FUSE FAILURE PROTECTION
87M	3 PHASE MOTOR DIFFERENTIAL PROTECTION

LEGEND DESCRIPTION

64R	RESTRICTED EARTH FAULT PROTECTION
51G	STAND BY EARTH FAULT PROTECTION
87T	3 PHASE BIASED TRANSFORMER DIFFERENTIAL PROTECTION
27M	3 PHASE UNDER VOLTAGE PROTECTION FOR MOTOR TRIPPING
27U	3 PHASE BUS UNDER VOLTAGE
27N	NO VOLT PROTECTION FOR BUS
50BF	CIRCUIT BREAKER FAILURE PROTECTION
86	LOCKOUT FUNCTION
3I	3 PHASE CURRENT MEASUREMENT
Io	NEUTRAL CURRENT MEASUREMENT
3U	3 PHASE VOLTAGE MEASUREMENT
Uo	RESIDUAL VOLTAGE MEASUREMENT
P	ACTIVE POWER MEASUREMENT
Q	REACTIVE POWER MEASUREMENT
E	ENERGY MEASUREMENT
PF	POWER FACTOR MEASUREMENT
HZ	FREQUENCY MEASUREMENT
HM	HOUR RUN METER

FOR TENDER PURPOSE ONLY

		एनटीपीसी लिमिटेड NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)																		
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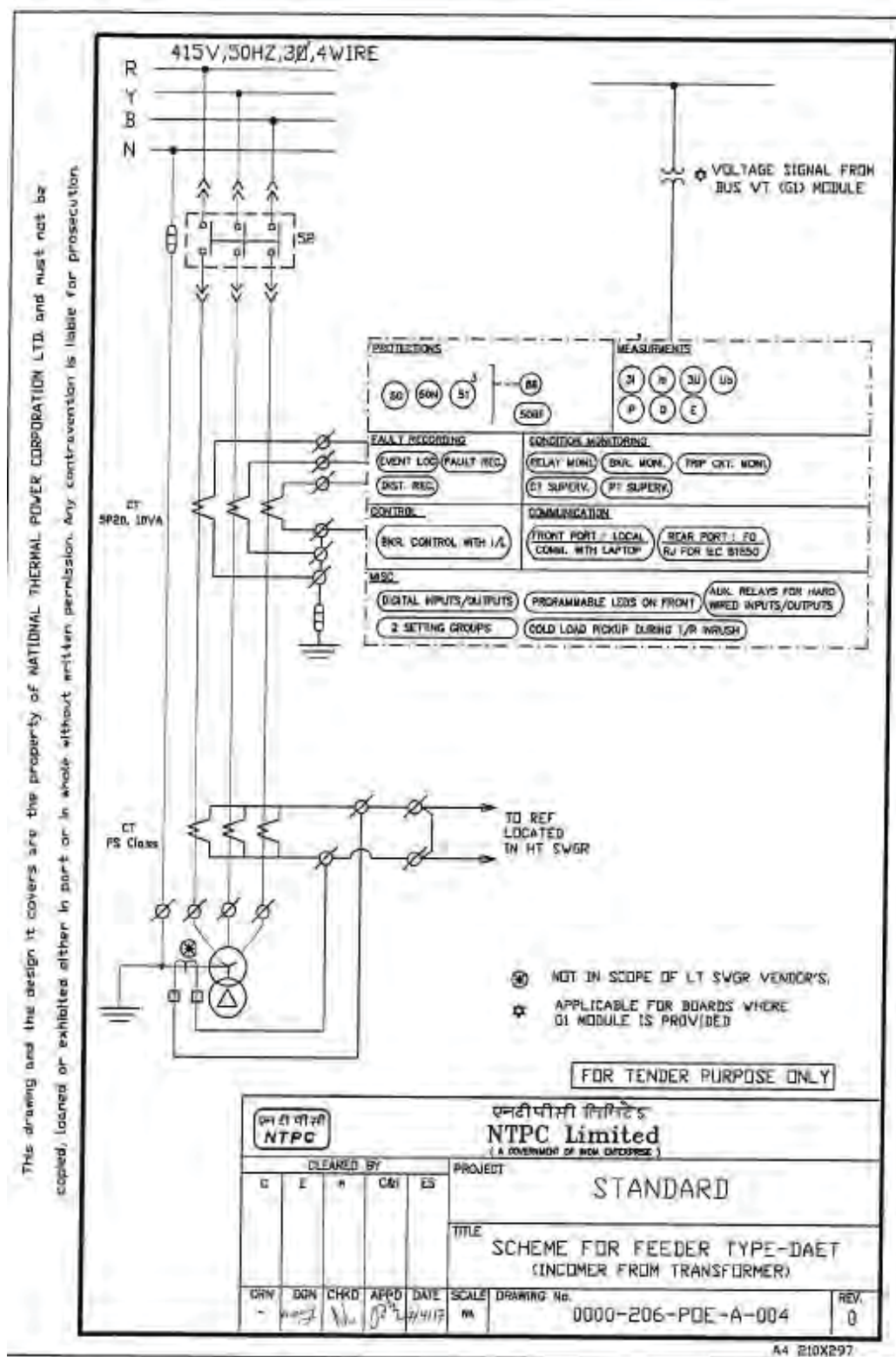
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LOT-IA PROJECTS
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE

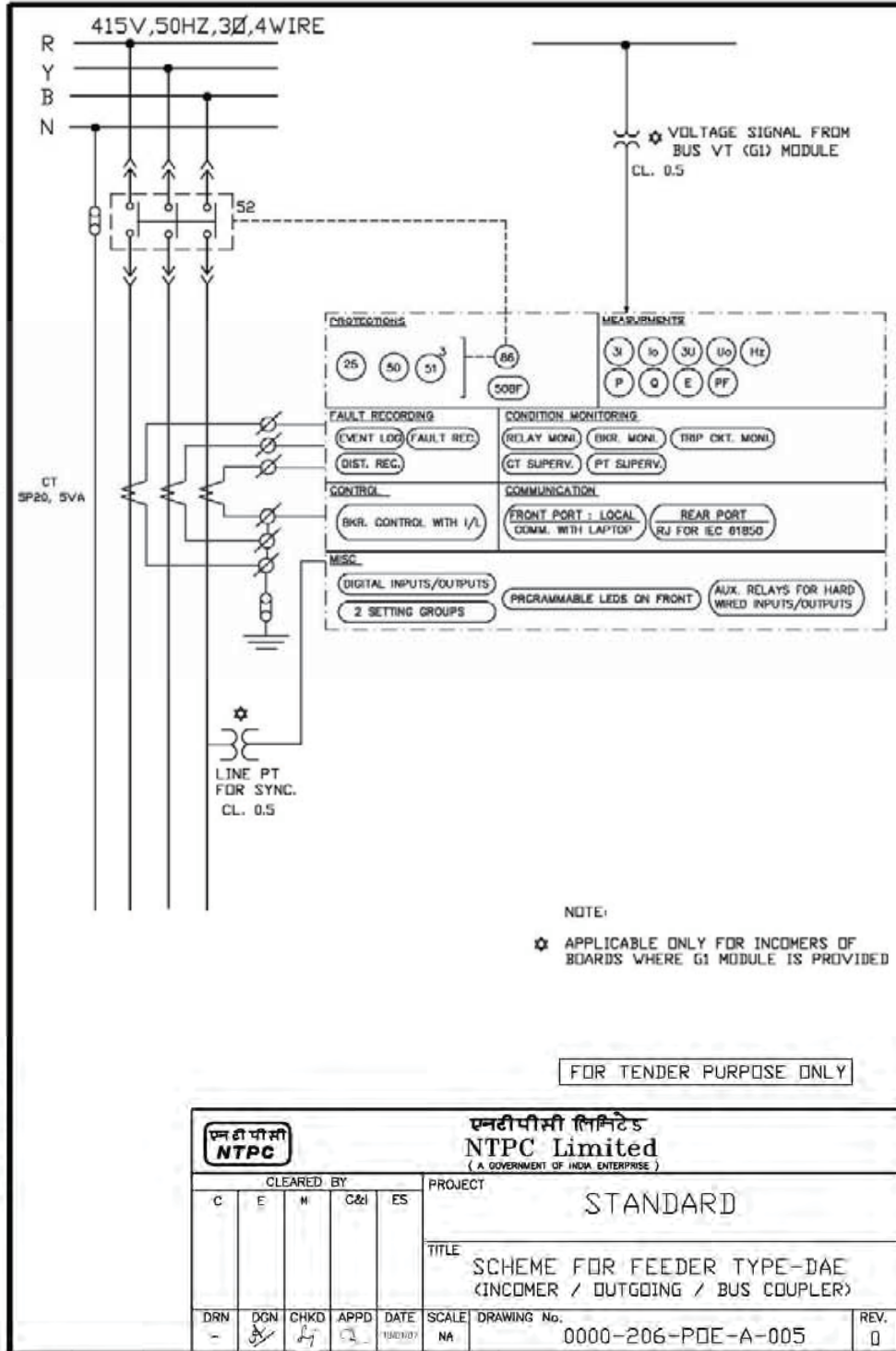
TECHNICAL SPECIFICATION
SECTION -VI, PART-B
BID DOC NO. : CS-0011-109(1A)-2

SUB SECTION II-E-10
LT SWITCHGEARS & LT
BUSDUCTS

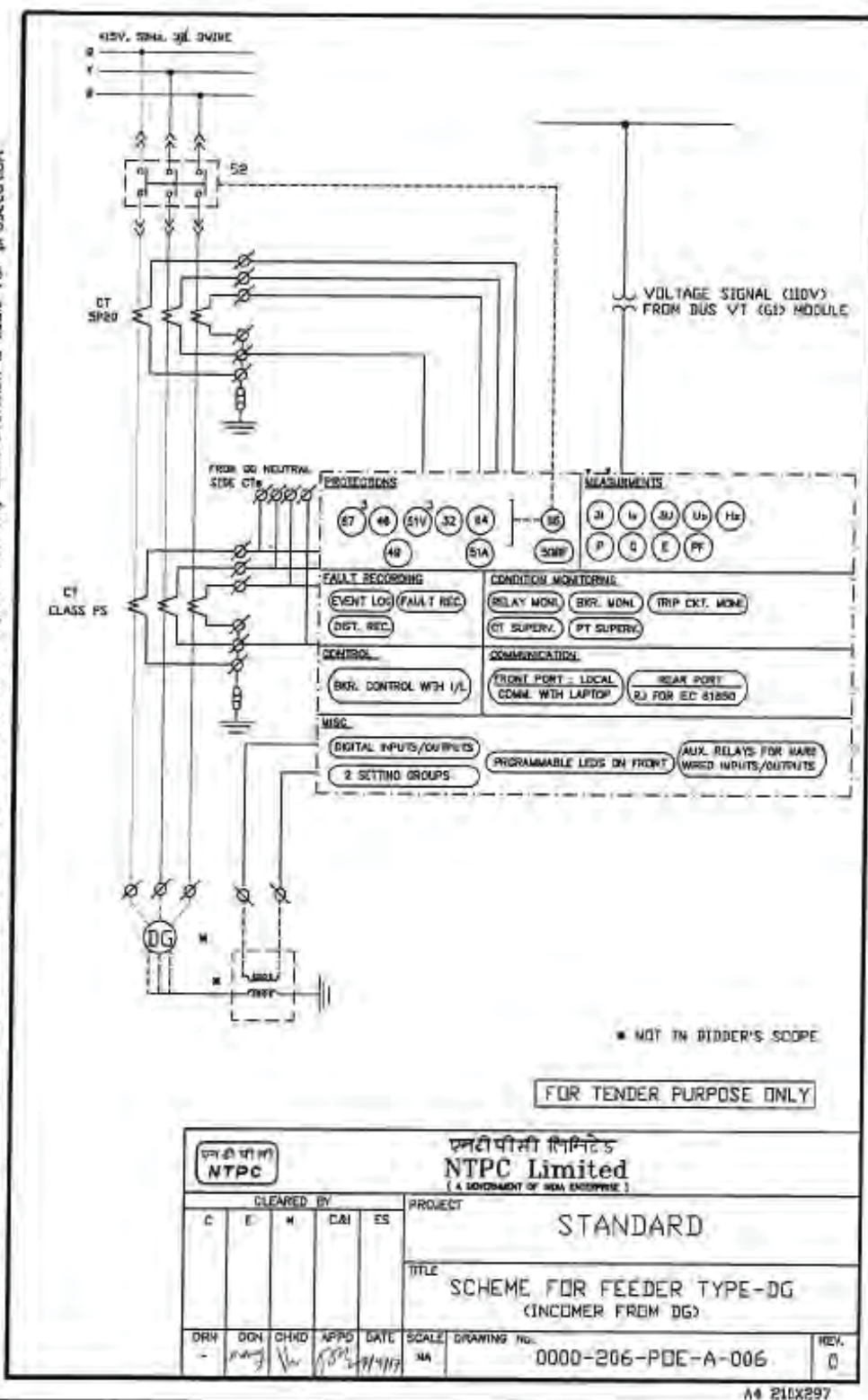
PAGE
47 OF 58



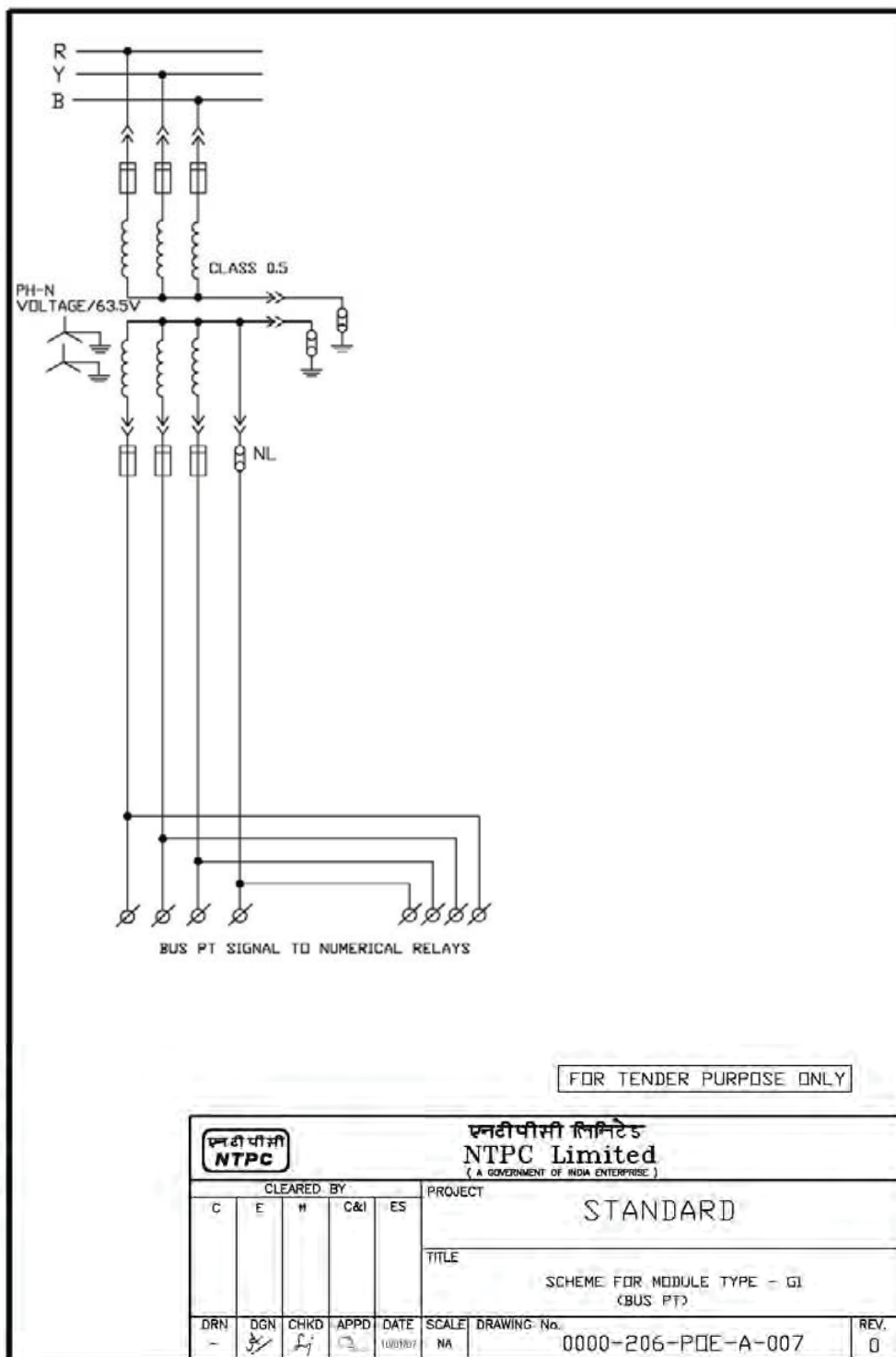
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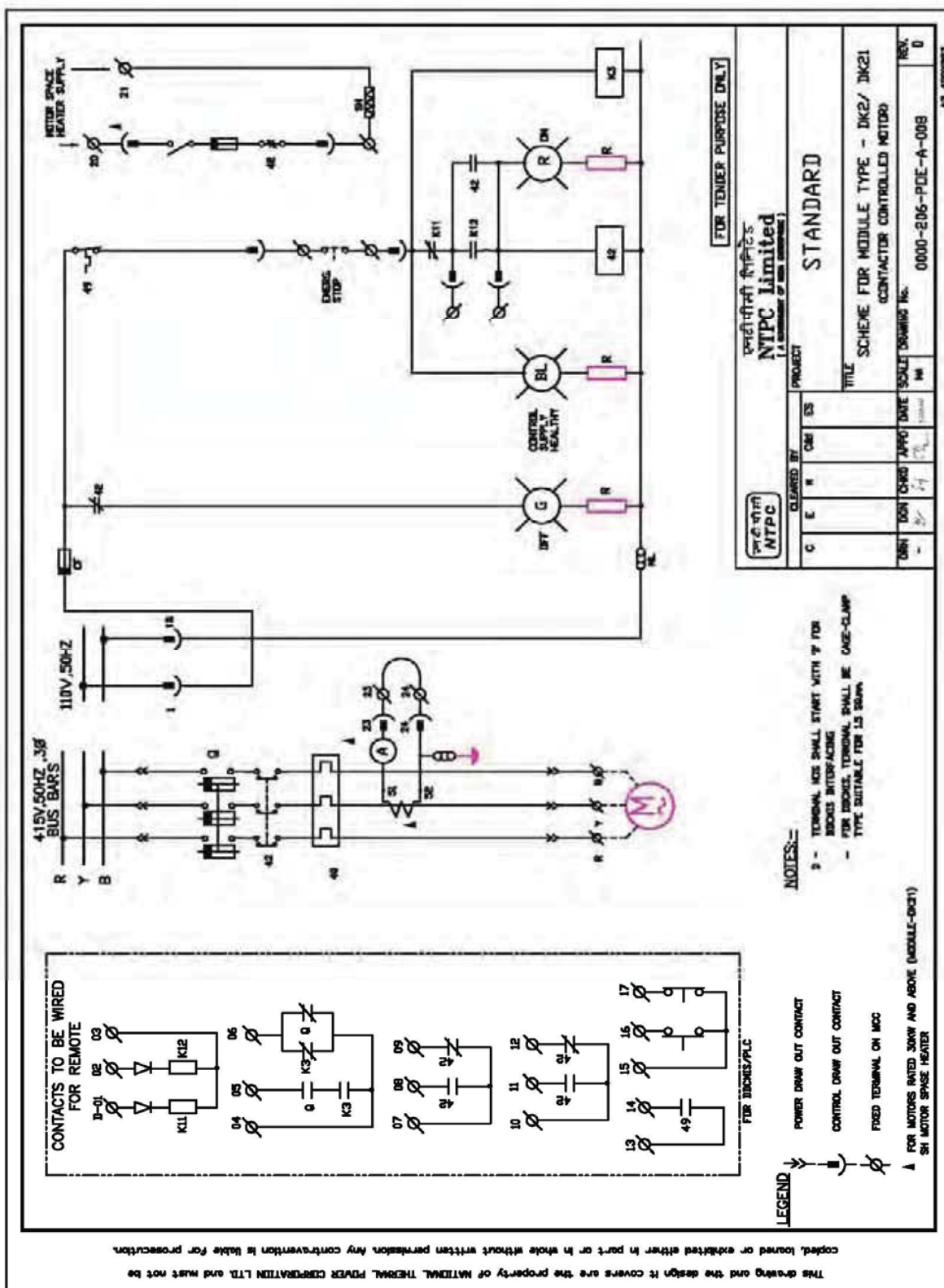
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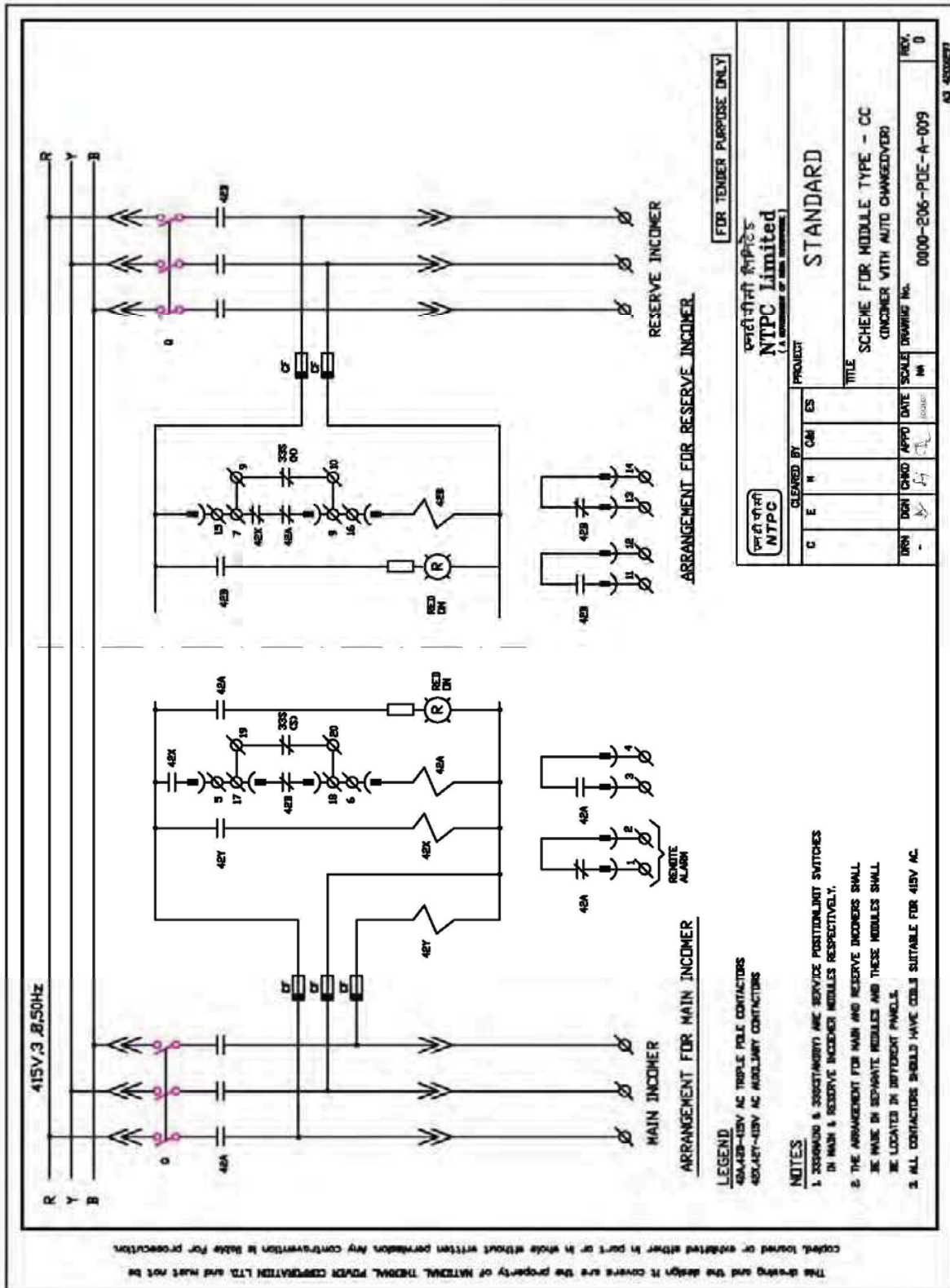


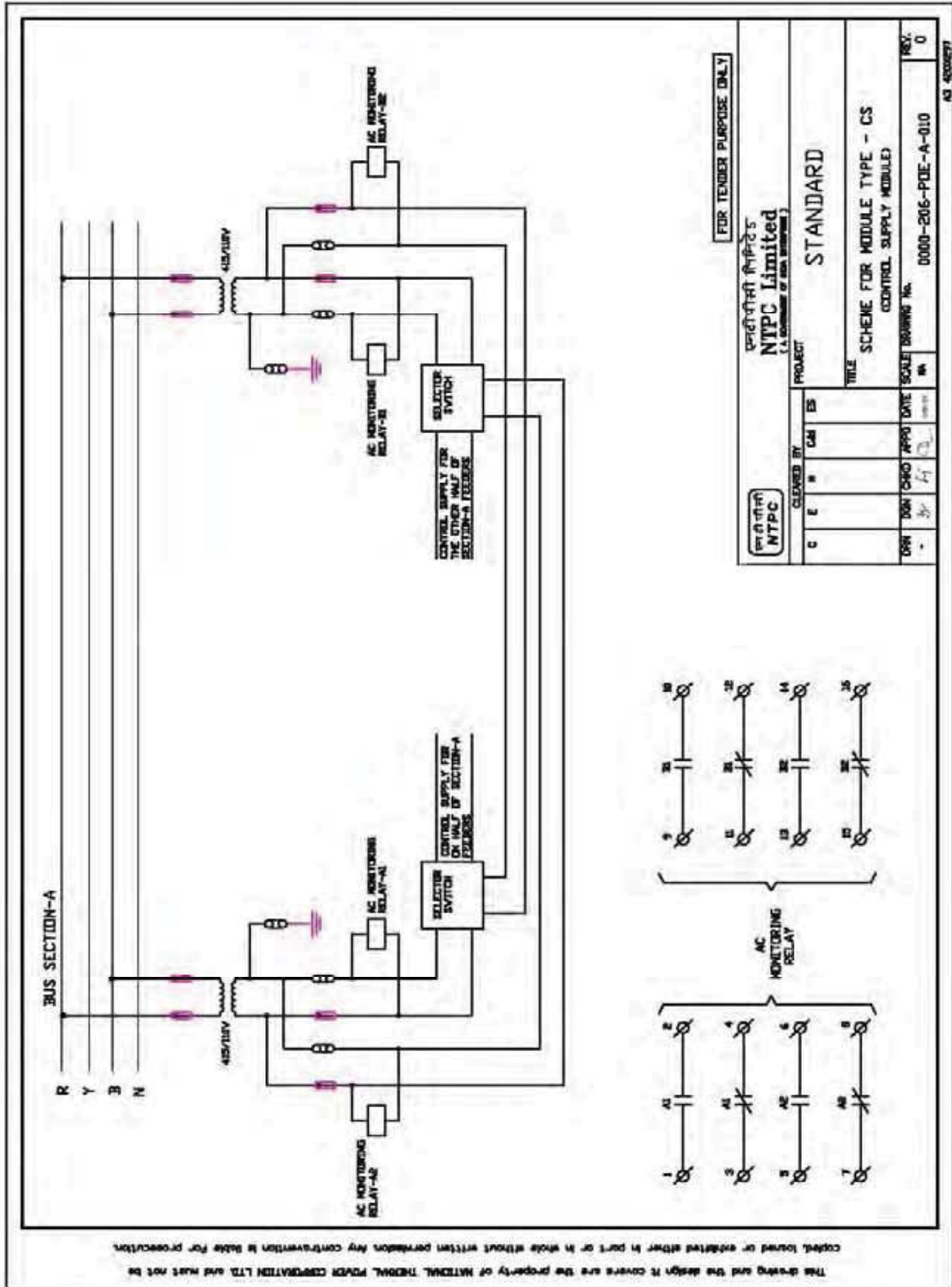
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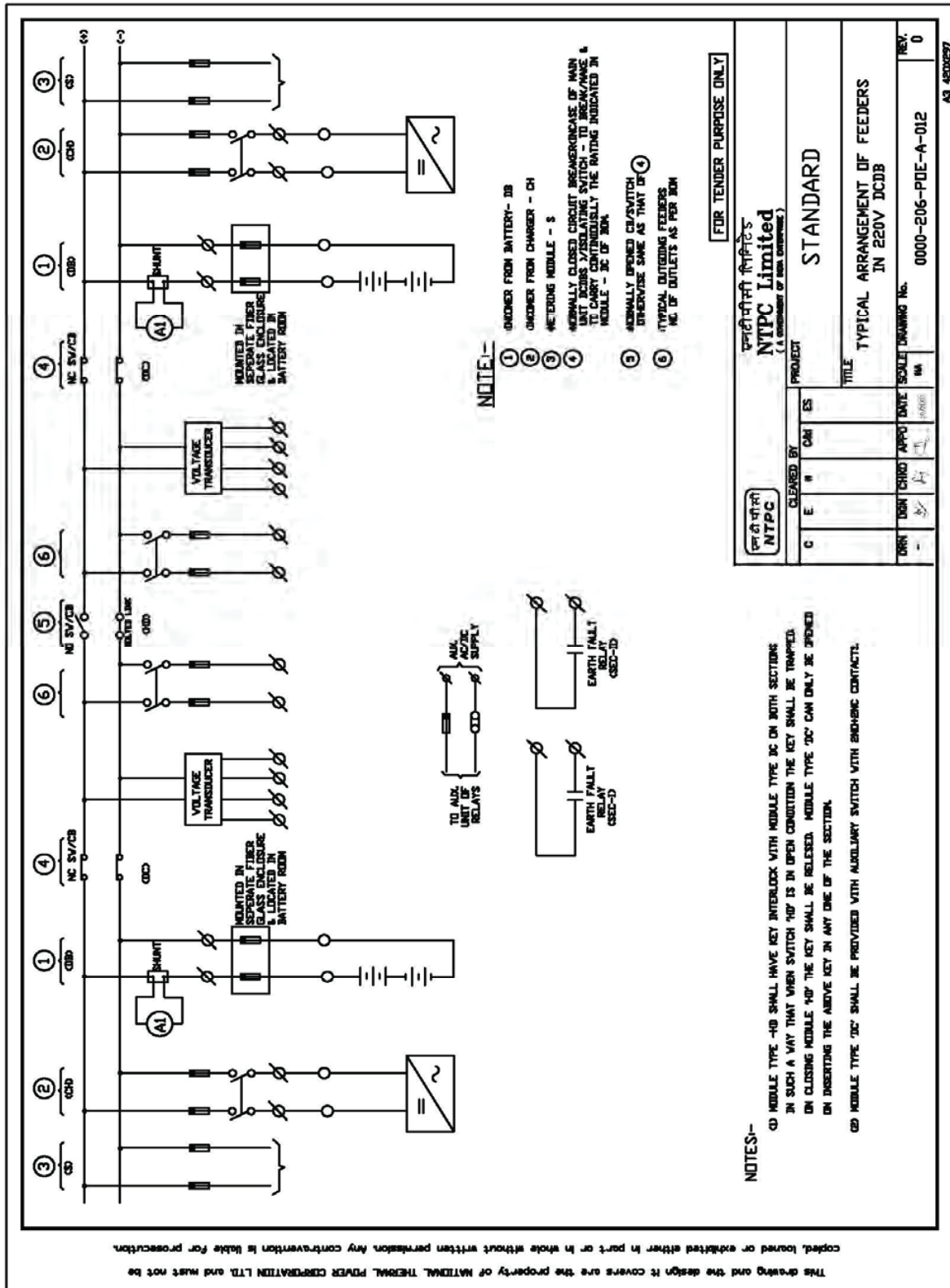


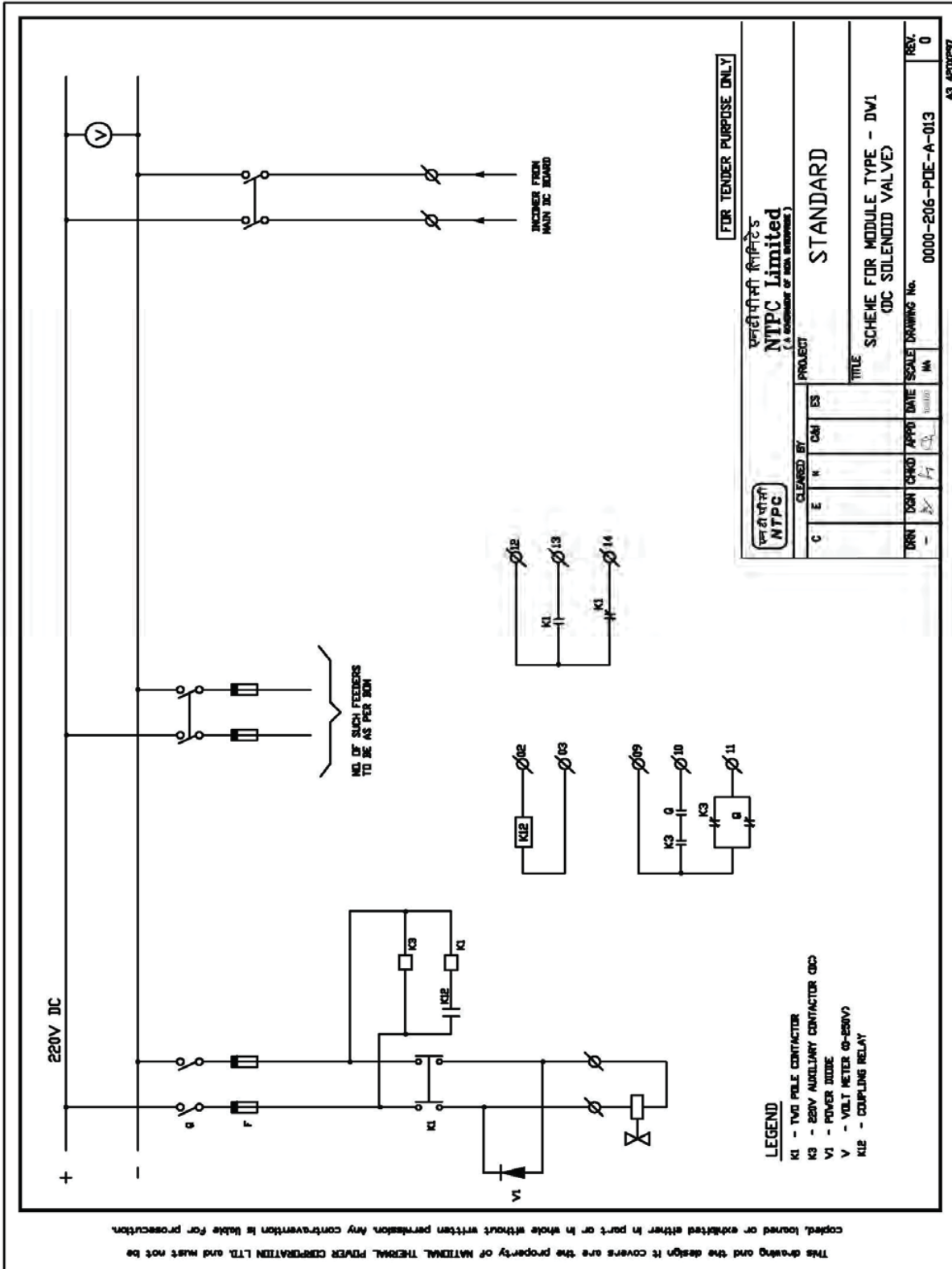
LOT-1A PROJECTS
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE

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

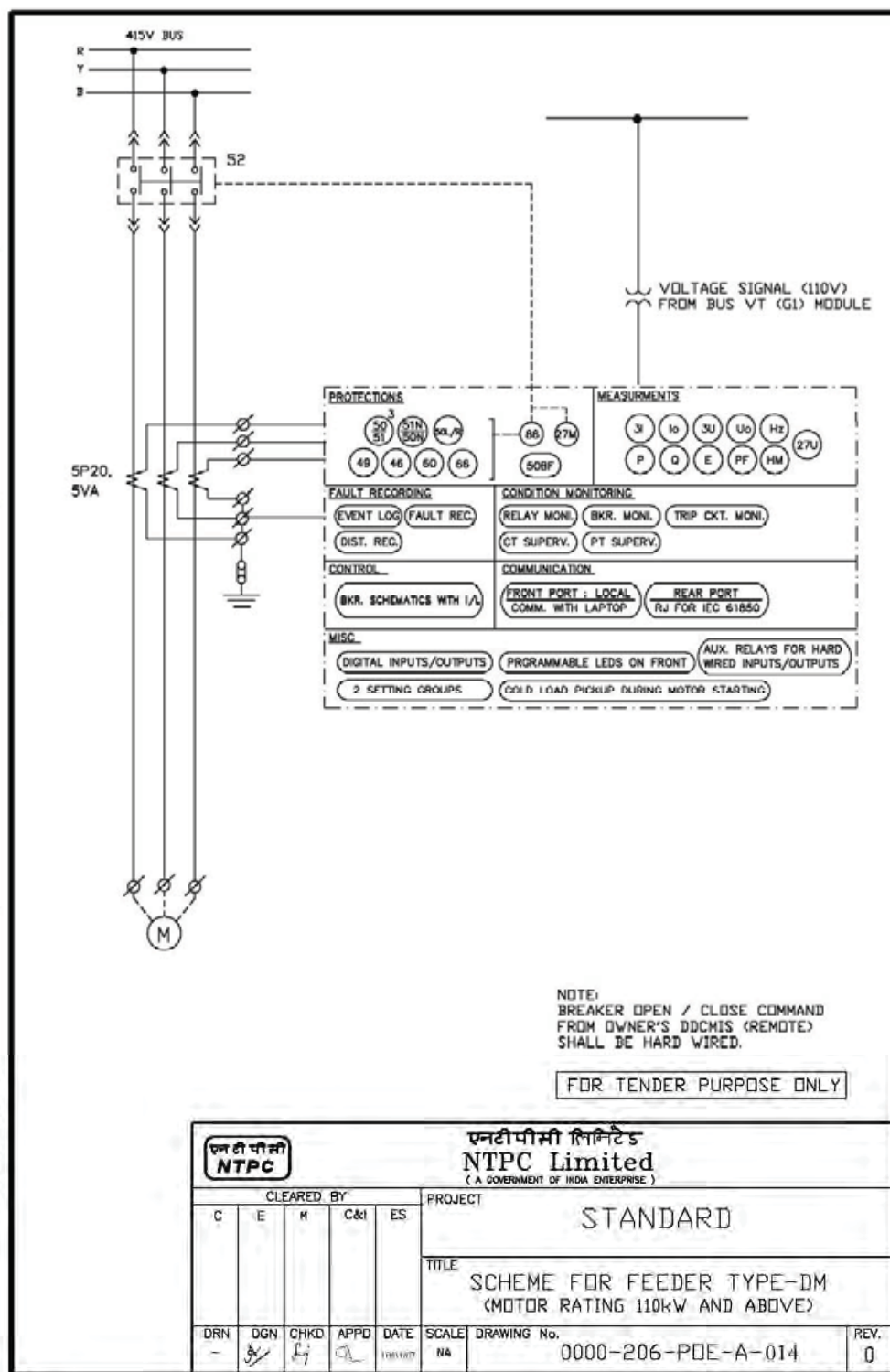
SUB SECTION II-E-10
LT SWITCHGEARS & LT
BUSDUCTS

PAGE
54 OF 58





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SUB-SECTION-II-E11

DIESEL GENERATORS

**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	
1.00.00	DIESEL GENERATORS CODES AND STANDARDS DIESEL ENGINE IS -10000, BS- 5514 INTERNAL COMBUSTION ENGINES (12 PARTS) IS -10000 SPEED OF DIESEL GENERATOR BS649 / 195B ALTERNATOR IS-4722/IEC-60034,IS12065, IS12075 PERMISSIBLE LIMITS OF NOISE LEVEL OF ROTATING MACHINES IS 12065 MEASURE, EVALUATION AND LIMIT OF VIBRATION SEVERITY OF ROTATING ELECTRICAL MACHINES SHAFT 65 MM DIA OR HIGHER IS 12075 DIESEL FUELS – SPECIFICATIONS IS1460 RECOMMENDED PRACTICE FOR HOT-DIP GALVANIZING OF IRON AND STEEL IS 2629 METHODS FOR TESTING UNIFORMITY OF COATING OF ZINC COATED ARTICLES IS 2633 CODE OF PRACTICE FOR FIRE – SAFETY IS 3034 RECIPROCATING INTERVAL COMBUSTION ENGINES iso 3046 OISD STANDARD ON Lightning Protection OISD-GDN-180	
1.01.00	The installation work shall conform to Indian Electricity Act and Indian Electricity Rules as amended up to the date this specification is issued. Any approval required from statutory authorities shall be obtained by the Contractor. Nothing in this specification shall be construed to relieve the Contractor of this responsibility.	
1.02.00	Equipment complying with other internationally accepted standards such as ASA, IEC, BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent to or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted and also furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments in force as on date of opening of techno-commercial bid. Bidder shall clearly bring out the salient features for comparison.	
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-II-E11 DIESEL GENERATORS Page 1 of 19

CLAUSE NO.	TECHNICAL REQUIREMENTS																																						
2.00.00	TYPE Diesel Engine Stationary type, turbo charged and water cooled. DG set including stack height, acoustics, air emission and fuel oil installation shall meet the requirement given by gazette notification of Ministry of Environment & Forest dated 17/05/02, 01/07/03, CPCB guidelines, all statutory requirement of Govt. of India and State Pollution Board Guidelines & as updated as on date of techno-commercial bid opening.																																						
3.00.00	TECHNICAL REQUIREMENTS <table><tr><td>a)</td><td>Net Electrical output</td><td>As per system requirement</td></tr><tr><td>b)</td><td>Ambient temperature</td><td>50 degree. (to be considered for deration of alternator)</td></tr><tr><td>c)</td><td>Relative Humidity</td><td>100%</td></tr><tr><td>d)</td><td>Fuel</td><td>HSD Fuel as per IS 1460</td></tr><tr><td>e)</td><td>Rated Speed</td><td>1500 rpm</td></tr><tr><td>f)</td><td>Governor(Electronic Type)</td><td>A1 type as per BS:5514</td></tr><tr><td>g)</td><td>Vibrations</td><td>Max. 250 microns peak to peak with anti-vibration pads</td></tr><tr><td>h)</td><td>Starting</td><td>Electrical self-starting</td></tr><tr><td>i)</td><td>Fuel service tank</td><td>8 hours running</td></tr><tr><td>j)</td><td>Air intake system</td><td>Dry type air filter, 15 micron size or better with 90% efficiency or better</td></tr><tr><td>k)</td><td>Cooling</td><td>Forced water cooled for Engine & Air cooled for Alternator.</td></tr><tr><td>l)</td><td>Paint Shade</td><td>Grey RAL9002</td></tr></table>			a)	Net Electrical output	As per system requirement	b)	Ambient temperature	50 degree. (to be considered for deration of alternator)	c)	Relative Humidity	100%	d)	Fuel	HSD Fuel as per IS 1460	e)	Rated Speed	1500 rpm	f)	Governor(Electronic Type)	A1 type as per BS:5514	g)	Vibrations	Max. 250 microns peak to peak with anti-vibration pads	h)	Starting	Electrical self-starting	i)	Fuel service tank	8 hours running	j)	Air intake system	Dry type air filter, 15 micron size or better with 90% efficiency or better	k)	Cooling	Forced water cooled for Engine & Air cooled for Alternator.	l)	Paint Shade	Grey RAL9002
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4.00.00	GENERAL																																						
4.01.00	BHP rating of the engine shall be Limited-time running Power (LTP) as per ISO 8528-1 considering deration for 50 deg C ambient temperature.																																						
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-II-E11 DIESEL GENERATORS																																				
			Page 2 of 19																																				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.02.00	The DG set shall be able to deliver specified net electrical out put while supplying power / driving all electrical and mechanical auxiliaries connected to alternator terminals and engine shaft			
4.03.00	The DG set shall also be able suitable for 12 hours continuous running of which one hour at 10% overload at rated speed.			
4.04.00	The DG set shall be capable of starting largest connected motor with terminal voltage drop being restricted to 15%. Generator loading before starting of this motor shall be considered as 50% of generator rating			
4.05.00	The DG Set shall be located inside the acoustic enclosure and kept outdoors. The exhaust shall be discharged through individual silencer & stack outside the enclosure. Necessary lightning protection as per OISD standard OISD-GDN-180 shall be provided by the bidder for the stack.			
4.06.00	Critical speed of the machine shall not be lesser than 120% of the normal speed.			
4.07.00	All couplings shall be capable of withstanding the maximum generator sudden short circuit torque.			
5.00.00	DUCTING, PIPING VALVES AND FITTINGS			
5.01.00	The engine shall be supplied with all necessary silencer, exhaust, piping, valves and fittings for the fuel oil, lubricating oil, engine starting, air inlet and engine exhaust system, alongwith expansion joints, drain plugs, flanges and their support structure etc.			
5.02.00	Maintenance and erection tools and tackles required for all the equipment shall be provided by the Contractor.			
5.03.00	Owner shall provide two(2) number of 3 phase, 3 wire, 415V feeder and two(2) number of 220V DC supply at one point. Further distribution for bidder's equipment shall be carried out by the bidder. Necessary starters for ventilation fans/ exhaust fans / accoustic enclosure and priming pump motors etc. shall be in the bidder's scope along with necessary AC distribution board, cables and cabling. Distribution board shall be metal enclosed, compartmentalised, wall/structure mounted and shall be fabricated out of cold rolled sheet steel of thickness 1.6mm with degree of protection of IP-54. The same shall be provided inside the acoustic enclosure. The alternator outgoing supply of DG Set shall be fed into employer's breaker panel.			
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-II-E11 DIESEL GENERATORS
Page 3 of 19				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.00.00	OPERATIONAL REQUIREMENTS			
6.01.00	Starting and Control			
6.01.01	All DG sets shall be controlled independently through separate control panel. The unit shall have integrated control with automatic starting sequence from the manually initiated command from a single push button. It shall also have auto initiation through command from remote from owner's panel. The DG set shall also issue automatic closing command to it's LT breaker on achieving rated voltage and frequency on it's terminals when controlled from remote. Necessary voltage and frequency relays for the purpose shall be included in the offer.			
6.01.02	The starting time required from the initiating signal until the operating speed and voltage is attained and the engine and generator are ready to take load, shall not be greater than 30 seconds. Three attempt starting facility shall be provided either by using two impulse timer and a summation timer or by using microprocessor based controller along with auxiliary panel if any. The DG set shall lockout automatically in case of failure of above. The DG shall be capable of being stopped manually from remote as well as local. Interlock shall be provided in DG control panel to prevent shutting down operation (when in auto mode) as long as the circuit at generator output is closed.			
6.01.03	Electrical self starting system shall be provided, the source of energy shall be batteries backed up by battery chargers which shall be supplied by the Contractor.			
6.01.04	The starter motor shall conform to IS: 4722.			
6.01.05	The fuel oil system and the lubricating oil shall also start operating simultaneously and automatically as soon as a starting impulse is received to obviate any chance of seizure of the piston and bearing as well as air locking in fuel supply system.			
6.02.00	Battery			
6.02.01	The battery shall be of at least 24V 360 AH or 2 sets of 2 numbers of 12 V, 180 AH battery connected in parallel and shall conform to the requirements of IS : 7372 /IEC:60095. The battery with Polypropylene containers meeting the other technical requirements of IS: 7372 may be acceptable.			
6.02.02	The battery for starting the engine shall be capable of performing six (6) normal start without recharging. The charger shall be protected by a suitable current limiting device. The battery shall be sized for site minimum temperature. Battery and battery charger shall also feed the control supply of DG control panel.			
6.02.03	The minimum voltage at the end of load cycle shall not be less than 1.75 volts per cell.			
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-II-E11 DIESEL GENERATORS	Page 4 of 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.00.00	DIESEL GENERATOR CONTROL PANEL			
7.01.00	Construction details			
7.01.01	The local control panel shall be of robust construction, floor mounting, free standing type made of 2.0 mm thick CRCA sheet steel including doors and Partition. Neoprene gaskets shall be provided between all openings and joints. It shall be provided with hinged door with locking arrangement. The control panels shall have IP-54 degree of protection as per IS: 13947 Part-I.			
7.01.02	The panel shall be painted with electro statically powder coated paint of shade RAL 7032 after necessary sheet metal treatment to remove dust, grease, oil, chemical compound, uneven surfaces and any foreign materials. The Gland plate shall be of at least 2.5mm thick sheet steel.			
7.01.03	Control panel with provision for local starting shall be provided which shall incorporate all controls required for starting, monitoring, regulating and stopping DG set. It shall be equipped with all necessary instrumentation to provide adequate surveillance of DG set under all operating conditions including 'Standby'.			
7.02.00	All indicating instruments shall be flush mounted conforming to industrial grade as per relevant IS.			
7.03.00	All cables shall be bottom entry. Enough space shall be provided in the control panel for easy access during maintenance and repairs.			
7.04.00	A tinned copper/ aluminium bar of adequate dimension shall be provided for earth connection complete with nuts and bolts as required for external connection to Empolyer's earth grid.			
7.05.00	The final paint shade shall conform to shade grey RAL 9002. The identification tag shall be white in colour shade RAL 9010.			
7.06.00	CT shorting links, test terminal blocks etc. shall be provided. All the equipment mounted inside the control panel shall be identified by lamicoid labels/ stenciling by paint.			
7.07.00	Panel shall be provided with panel illumination lamp operated by the door switch and thermostat-controlled space heater. Control panel shall be furnished complete with all accessories and wiring for safe and trouble free operation of the system.			
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-II-E11 DIESEL GENERATORS	Page 5 of 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.08.00	Fuses			
7.08.01	All fuses shall be of HRC cartridge link type. Screw type fuses are not acceptable.			
7.09.00	Relays			
7.09.01	A voltage relay for sensing the supply to control Panel shall be provided. The relay shall operate at about 90% of voltage and shall be English Electric type VAG 11 or equivalent.			
7.10.00	The Control panel shall be complete with the following			
7.10.01	Microprocessor base control unit			
	Microprocessor base control unit with following.			
	(a.) Voltage sensing mains supply failure monitor			
	(b.) Auto engine start / stop & failure to start lock out.			
	(c.) Generator voltage & frequency sensing			
	(d.) Selector switch and push button to facilitate remote starting/stopping, speed & voltage control			
	(e.) Manual / Auto / Test selector switches			
	(f.) DG start /stop push button			
	(g.) DG Incomer Breaker close / trip push button			
	(h.) Mains breaker close / trip push button			
	(i.) Auto manual Speed adjustment			
	(j.) Auto manual Voltage adjustment			
	(k.) Auto manual selector switch for priming pump motor (if required)			
7.10.02	LED indication lamps			
	LED indication lamp shall be provided for the following			
	(a.) ‘DG ON’ indication lamp‘			
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-II-E11 DIESEL GENERATORS	Page 6 of 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.10.03 7.10.04	(b.) DG Breaker ON' indication lamp (c.) 'Mains ON' indication lamp (d.) 'Mains Breaker ON' indication lamp. (e.) Charger ON indication lamp. Annunciation Annunciation for the following shall be provided with fault indication, alarm & trip contact, accept, reset and test facility. Any one or more of the following defects shall cause the alarm or running diesel generator to be tripped. In case of tripping, re-start shall be prevented until the fault(s) are removed and manual resetting is done. Separate indicators shall be provided for each of the following in control panel: (a.) Engine fails to start(Alarm) (b.) Low lube – oil pressure.(Trip) (c.) High cooling water temperature.(Trip) (d.) D.G. overload.(Alarm) (e.) DC failure (f.) DG over speed(Trip) (g.) Fuel level low in day tank(Alarm) (h.) Fuel level very low in day tank(Trip). (i.) Generator stator temperature high.(Alarm) (j.) Electrical protection operated.(Trip) (k.) Incomer to emergency switchgear from DG closed. (l.) Earth fault (alarm) input from owner's switchgear. (m.) Lub Oil Priming Pump (if applicable) 'Fault' indication Metering Following meters shall be provided in the panel: (a.) AC voltmeter (b.) AC Ammeter			
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-II-E11 DIESEL GENERATORS	Page 7 of 19

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
7.10.05	(c.) Frequency meter (d.) Electronic Kwh meter with counter display. (e.) KW meter (f.) PF Meter Battery charger (a.) A suitable battery charger shall be housed inside the panel to recharge the battery within ten hours. The battery charger shall be SMPS based automatic and shall be complete with the following (b.) DC voltmeter (c.) DC Ammeter (d.) Float / Boost selector switch (e.) Auto / Manual selector switch for Boost to float change over. (f.) The charger shall have necessary filters to reduce the ripple factor less than three (3) and suitable dropping characteristics by means of choke and/ or suitable input transformer impedance to automatically reduce the charging current as the battery gradually charges up.			
7.11.00	Suitable 4-20mA transducers with dual output shall be provided in the control panel for voltmeter & frequency meter for owner's use at remote.			
7.12.00	The bidder is required to provide coupling relays (with diodes) having 24V DC energising coil in the control panel for the followings for owner's use (a.) DG Start (b.) DG Stop (c.) DG Voltage raise (d.) DG voltage lower (e.) DG speed raise (f.) DG speed lower (g.) DG auto start			
7.13.00	For issuing simultaneous start command to standby DG set, there shall be three (3) 'DG auto start' coupling relays in case of standby DG set.			
7.14.00	Provision for following status/ signal for Employer's information shall be provided in the DG control panel for both main & standby DG Sets: (a.) DG fail to start. (b.) DG start command actuated/ reset.			
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-II-E11 DIESEL GENERATORS	Page 8 of 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(c.) DG working/ stop signal. (d.) DG trouble/ normal signal. (e.) DG control supply failure/ normal signal.			
7.15.00	The requirement of CT, VTs, relays, timers, auxiliary contacts shall be as per the system requirement.			
7.16.00	The bidder shall supply any other controls and indications for diesel generator set though not specifically mentioned here but which the supplier may recommend and are required to make system complete for satisfactory operation of DG sets.			
7.17.00	Indicating lamps shall be of the panel mounting LED type with series resistor and of low power consumption. Lamps shall be provided with series resistor built-up lamp assembly.			
7.18.00	Necessary pressure switches, level switches, thermostats, flow switches, auxiliary relays, etc. required for the above alarm and annunciation system shall be furnished under the scope of this specification.			
8.00.00	DIESEL ENGINE			
8.01.00	CONSTRUCTIONAL FEATURES			
8.01.01	Diesel engine shall be mounted on visco damper type vibration dampening system or equivalent anti-vibration mounting system (as recommended by Engine manufacturer) and shall be complete with integral air intake through dry type air filters and exhaust systems, metering facility, speed regulation system, fuel injection system, lube oil system, primary cooling water system along with necessary filters, silencers, ducts, exhaust, piping and fittings, valves, instruments, etc. as required.			
8.01.02	The generating unit shall be complete with all auxiliaries and its performance, torsional vibration, materials and workmanship, etc. shall be in accordance with the standard practices of diesel engine manufacturer's association in USA. IS-10000, BS-5514 or equivalent. The engine shall be properly balanced so as to transmit only small unbalanced forces to the foundation.			
8.02.00	DIESEL OIL SYSTEM			
8.02.01	The diesel oil system as provided shall be complete with simplex type filters, hoses, piping, fittings, relief valves, supports, control and instrumentation and all other accessories to make it complete.			
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-II-E11 DIESEL GENERATORS	Page 9 of 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.02.02	The fuel consumption of the engine at full and three quarters of its rated power output shall be indicated by the bidder.			
8.02.03	A day oil tank of 990 litres fuel capacity shall be provided by the bidder, mounted on fabricated steel platform outside the acoustic enclosure. The tank shall be complete with level indicator marked in Litres, two nos. of level switches, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. All pipe joints shall be brazed/ welded.			
8.03.00	Lubricating oil System			
8.03.01	Automatic pressure lubrication shall be provided by a shaft driven gear type pump through an oil cooler and fin mesh filters to the end bearing, camshaft bearings, camshaft chain and gear drives, governor, air starting, distribution, auxiliary drive gears etc.			
8.03.02	Hand driven and/ or A.C. motor driven lube oil priming pump (if applicable) along with starter is to be provided as recommended by the engine manufacturer.			
8.03.03	All necessary accessories like pressure gauges, temperature and oil level indicators, pressure relief valves, bypass valves, pressure switches for alarm and control shall be furnished by the Contractor together with all inter connecting piping, fittings, supports, valves, etc.			
8.03.04	A lubricating oil filter shall be provided for operation under normal conditions for period of a more than 250 hours without the necessity of its replacement or cleaning.			
8.04.00	Cooling System			
8.04.01	Jacket water cooling system is offered, same be in closed cycle and shall have radiator located in front of the engine with a fan driven mechanically from the engine shaft. Forced water circulation by means of pump driven by the engine shaft shall be employed. The radiator tubes shall be of copper with sufficient heat transfer area. However, radiator tubes designed with better heat transfer capability, as recommended by engine manufacturer, shall also be acceptable.			
8.05.00	Governing System			
8.05.01	The governor shall be electronic type with class A1 type as per BS-5514.			
8.05.02	The governor shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However a tripping shall be provided even if speed exceeds the maximum permissible limit.			
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-II-E11 DIESEL GENERATORS
Page 10 of 19				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
8.06.00	Ancillary Equipment The following equipment as per system requirements shall be included: (a.) Flywheel (b.) Fuel piping (c.) RPM indicator (d.) Lubricating oil cooler (if applicable) (e.) Exhaust silencer and piping (f.) Fuel and lubricating oil filters, air filters. (g.) Temperature gauges for water. (h.) Pressure gauges for lubricating oil (i.) Hand barring gear. (j.) Necessary foundation bolts and base channels for the engine, alternator, fuel service tank and for all other equipment included in this package. (k.) Base frames (l.) Starting equipment (m.) Protective equipment preferably in the form of fuel cut-off solenoid and suitable relays to protect the engine against low lubrication pressure. (n.) Lifting attachment for lifting the complete set or the engine alternator separately. (o.) Radiator. (p) Any other ancillary equipment not specifically mentioned in the specification but are necessary for proper operation and maintenance of the set and safety of operating personnel.		
9.00.00 9.01.01	GENERATOR The generator shall be of totally enclosed or screen protected drip proof and self air cooled type. The generator shall be driven by the Diesel engine specified above and shall match the same in all respects. The generator shall conform to IS 4722 or IEC-60034.		
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-II-E11 DIESEL GENERATORS	Page 11 of 19

CLAUSE NO.	TECHNICAL REQUIREMENTS												
9.01.02	AC generator shall be supplied along with it's excitation system, AVR and include all necessary auxiliaries.												
9.02.00	Rating												
9.02.01	The Generator shall be star connected-3-phase, 50 Hz synchronous generator and shall have a continuous rating. The continuous rating of the alternator under the specified ambient condition shall be at least equal to the net electrical output specified for the DG set plus the power requirements of all electrical auxiliaries connected to the alternator terminal including excitation (if it is taken from alternator terminals). The operating condition for each electric generator shall be as follows: <table><tr><td>a)</td><td>Voltage</td><td>415V</td></tr><tr><td>b)</td><td>Frequency</td><td>50Hz (+3 to -5%)</td></tr><tr><td>c)</td><td>Power factor</td><td>0.80</td></tr></table>				a)	Voltage	415V	b)	Frequency	50Hz (+3 to -5%)	c)	Power factor	0.80
a)	Voltage	415V											
b)	Frequency	50Hz (+3 to -5%)											
c)	Power factor	0.80											
9.03.00	Conductor, Insulation and Temperature Rise of Winding and Core												
	All insulated winding conductors of alternator shall be of copper. The generator stator and rotor windings core insulation and all connections including main and neutral leads shall have insulation conforming to IEC-60034 Pt.-I. The winding shall be given power house treatment i.e. two coats of varnish and backing followed by final coat of resin. The total insulation shall be non hygroscopic. The temperature rise of the stator core and mechanical parts in contact with or adjacent to winding shall not exceed the specified limits of IEC-60034 Pt.-I.												
9.04.00	Temperature Detectors.												
9.04.01	Six numbers of Duplex type or 12 nos. Simplex type Resistance element temperature detector (RTD) shall be suitably distributed at locations where highest temperatures may be expected in stator windings and one (1) element in each bearing. The RTD's shall comply with the latest edition of IS:2828.												
9.05.00	Space Heaters												
9.05.01	Suitably rated 240 V, single phase, 50 Hz, space heater located in lower part of alternator shall be provided to maintain the internal temperature above the dew point to prevent moisture condensation on the insulation when the set is not running. These heaters shall be switched on automatically, when DG set is not working.												
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-II-E11 DIESEL GENERATORS	Page 12 of 19									

CLAUSE NO.	TECHNICAL REQUIREMENTS										
9.06.00	Terminal Box For each DG set, separate terminal boxes shall be provided for phase and neutral side of leads. The terminal boxes shall be dust tight, weather proof having degree of protection of IP-54 as per IS: 13947. The terminal box shall be suitable for terminating LT bus ducts/cables. As far as possible connection between exciter and alternator shall be contained within the machine frame and connections carrying AC and DC current shall be segregated from each other. The necessary CT's for differential protection shall be provided on neutral side. The neutral point shall be brought to DG control panel and shall be connected to 300/100V VT, to be supplied and mounted inside the DG control panel by the bidder for earth fault detection.										
9.07.00	Alternator vibration level shall not exceed the values as defined in IS:12075. Alternators in case driven by Diesel engine shall be able to withstand vibration level of 9mm/sec. as per BS 5000 Part III,										
9.08.00	The generator shall be complete with voltage transformers necessary for AVR/ Synchronisation. The VT turns ratio shall preferably be 440/110 V. The VTs shall be supplied and mounted inside the DG control panel.										
9.09.00	Excitation System										
9.09.01	The generator shall be provided with complete excitation system capable of supplying the excitation current of the generator under all conditions of output from no load to full load and capable of maintaining voltage of the generator constant within +/- 1% of set value. The setting range available on voltage regulator shall be at any value with +/- 10% of the rated voltage. It shall be possible to set the same from remote also.										
9.10.00	TECHNICAL PARAMETERS OF CURRENT AND POTENTIAL TRANSFORMERS TO BE SUPPLIED BY THE BIDDER.										
9.10.01	Neutral side current transformers for differential protection: <table><tr><td>(a.) Type</td><td>Cast resin, bar primary</td></tr><tr><td>(b.) Voltage</td><td>660V, 50Hz</td></tr><tr><td>(c.) Ratio</td><td>2500/1A</td></tr><tr><td>(d.) KPV</td><td>>= 125V</td></tr></table>			(a.) Type	Cast resin, bar primary	(b.) Voltage	660V, 50Hz	(c.) Ratio	2500/1A	(d.) KPV	>= 125V
(a.) Type	Cast resin, bar primary										
(b.) Voltage	660V, 50Hz										
(c.) Ratio	2500/1A										
(d.) KPV	>= 125V										
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-II-E11 DIESEL GENERATORS Page 13 of 19								

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.10.02	(e.) RCT	=< 3 ohm		
	(f.) Class	PS		
	(g.) One minute power frequency withstand voltage	2.5KV		
	Single phase voltage Transformers (Neutral)			
	(a.) Type	Cast resin		
	(b.) Voltage Ratio	300/100		
	(c.) Accuracy	1.0 class		
9.10.03	(d.) Rated Voltage factor	1.2 continuous		
	(e.) VA Burden	20VA		
	(f.) One minute power frequency withstand Voltage	2.5kV rms		
	Voltage Transformers for Metering			
	(a.) Type	Cast resin		
	(b.) Voltage Ratio	440/110		
	(c.) Accuracy class	1.0		
10.00.00	(d.) Rated Voltage factor	1.2 continuous		
	(e.) Burden	100VA		
	(f.) One min power frequency with stand voltage	2.5kV rms		
	SOUND PROOFING SYSTEM			
	10.01.00	Bidder shall furnish design calculation for sound proofing/ ventilation system. The detailed frequency response for noise absorbing characteristic of acoustic material shall be furnished.		
	10.02.00	The sound absorptive layer shall comprise of bonded type mineral wool/glass wool of adequate thickness and density to comply the design requirements.		
	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-II-E11 DIESEL GENERATORS

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.03.00	DG shall be placed inside acoustic enclosure, the acoustic enclosure shall be placed in outdoor area. The requirements of acoustic enclosure are as following:			
10.03.01	The acoustic enclosure shall be fabricated from 2.0 mm thick CRCA sheet with steel section & frame of suitable size. The construction shall be modular type to facilitate dismantling as required for maintenance. The frame shall be of sufficient stiffness and rigidity. The enclosure shall be suitable for outdoor duty. The sheet and all sections shall be powder coated shade of grey RAL9002. A minimum clear space of 800mm shall be kept inside the enclosure.			
10.03.02	The exposed surface of lining shall be retained in place by minimum 1.0mm thick CRCA/ aluminium perforated sheet. Absorptive lining shall be provided between the perforated sheet and absorbing material. Necessary acoustic sealing shall be done in the panels/ modular unit joints.			
10.03.03	Enclosure shall be provided with adequate lighting. Enclosure shall be provided with adequate number of door and viewing glass.			
10.03.04	All hardware shall be of mild steel & shall be electro-galvanised.			
10.04.00	The door design shall be generally compatible to the enclosure design. The bonded mineral wool slab of adequate thickness shall be used. The door shall be provided with heavy duty hinges and handles. The sealing shall be done with neoprene/ silicon rubber gasket to avoid leakage of noise. The size of the door shall be as per the functional requirements.			
10.05.00	Suitable louvers with acoustic treatment shall be provided by the bidder as required.			
10.06.00	Ventilation system of adequate capacity shall be provided. The system shall comprise of tubular axial flow fans for air intake and air exhaust with splitter silencer. The ventilation shall be design to ensure required air flow rate as per manufacturer recommendations, after providing necessary acoustic treatment/ silencers in air flow path. The ventilation system shall be design to prevent leakage of sound and temperature shall not increase by more than 5 degree centigrade when DG is running continuously at specified rating.			
10.07.00	The construction of ventilation duct shall be from 1.6 mm thick CRCA perforated sheet. Other constructional details shall be similar to that of the accoustic enclosure.			
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-II-E11 DIESEL GENERATORS	Page 15 of 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.08.00	The exhaust air from radiator shall be discharge through modular duct of adequate size.			
10.09.00	The acoustic enclosure shall have suitable opening for routing out of LT bus ducts/cable from alternator terminal box. Further suitable acoustic treatment of the opening shall be done to achieve the desired acoustic level.			
10.10.00	Any other facility required to achieve the desired acoustic level shall be in the bidder's scope.			
11.00.00	TYPE TESTS			
11.01.01	All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to the date of techno-commercial 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.			
11.01.02	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of techno-commercial bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.			
11.01.03	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.			
11.01.04	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.			
11.02.00	Type test reports for the following type tests shall be submitted:			
11.02.01	Type test reports on Engine This shall be as per ISO-3046 (Table-1).			
11.02.02	Type test reports on Alternator (a.) Measurement of resistance			
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-II-E11 DIESEL GENERATORS	Page 16 of 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(b.) Phase sequence test (c.) Regulation test (d.) Measurement of open circuit and short circuit characteristics (e.) Efficiency test (f.) Temperature Rise Test (g.) Momentary overload test (h.) Over speed test (i.) High Voltage test (j.) Insulation resistance test (both before and after High Voltage Test) (k.) Noise level as per IS:12065 (l.) Vibration as per IS: 12075. (m.) Determination of Deviation of voltage waveform from sinusoidal. (n.) Degree of protection test on control panel for IP-52			
12.00.00	COMMISSIONING CHECKS			
12.01.00	In addition to the checks and test recommended by the manufacturers, the contractor shall carryout the following commissioning test on each set at site. The contractor shall arrange the testing equipment, instruments, fuel and any other facility required to carry out these tests.			
12.01.01	Load Test The engine shall be given test run for a period of at least 6 hours. The set shall be subjected to the maximum possible load as decided by Project Manager without exceeding the specified DG set rating. During the load test half hourly records of the following shall be taken: (a.) Ambient temperature. (b.) Exhaust temp. if exhaust thermometer is fitted.			
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-II-E11 DIESEL GENERATORS	Page 17 of 19

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(c.) Cooling water temp. at a convenient point adjacent to the water output from the engine jacket. (d.) Lubricating oil pressure. (e.) Speed. (f.) Voltage, wattage and current output. (g.) Oil tank level.			
12.01.02	Insulation Resistance Test for Alternator Insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with a 500 V megger shall not be less than $IR= 2x$ (rated voltage in KV) + 1.			
12.01.03	Check of fuel consumption A check of the fuel consumption shall be made throughout the load run test. The fuel consumption should not exceed the design values.			
12.01.04	Insulation Resistance of Wiring Insulation resistance of control panel wiring shall be checked with 500V megger. The IR shall not be less than one mega ohm.			
13.00.00	FUNCTIONAL TESTS Following functional tests are to be carried out at site:			
13.01.00	Functional tests on control panel.			
13.02.00	Functional tests on starting provision on the engine.			
13.03.00	Functional tests on all field devices.			
13.04.00	Functional tests on DG Set complete with AVR and speed governor.			
14.00.00	MEASUREMENT OF VIBRATION			
14.01.00	The vibration shall be measured at no load and at load as close to maximum achievable load and shall not exceed 250 microns. Any modification/rectification required to bring down the vibration level with in allowable limits specified by the			
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-II-E11 DIESEL GENERATORS
Page 18 of 19				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	manufacturer shall be done by the contractor. Vibration test is to be carried out at site.			
15.00.00	NOISE LEVEL (SOUND PRESSURE LEVEL) CHECK			
15.01.00	Noise level measurement shall be done generally following the guidelines given in IS:12065. The measurement shall be carried out with a calibrated integrating sound level meter as per IS:9779. This test is to be carried out at site.			
16.00.00	INSTALLATION OF DG SETS			
16.01.00	The installation, testing and commissioning of Diesel-Generator sets shall be carried out by the Contractor strictly in accordance with the applicable Codes of practice, the manufacturer's instructions, drawings etc., and/or as directed by the Employer.			
16.02.00	The Contractor shall install and commission the DG set, control panels, along with other accessories, starting equipment (Battery & battery charger/ compressed air system), fuel oil tank and fuel oil piping upto the DG sets. Minor civil works like fixing of anchor bolts, grouting etc. wherever required shall be done by the Contractor. The Contractor shall provide all tools, equipment and instruments required for <i>installations, testing</i> and commissioning.			
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-II-E11 DIESEL GENERATORS	Page 19 of 19

SUB-SECTION-II-E12

OUTDOOR TRANSFORMERS

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	
1.00.00	TECHNICAL PARAMETERS			
	1.01.00	Outdoor Transformers		
		(a)	Rated output	As per Requirement
		(b)	Cooling	ONAN
		(c)	Type	Two winding
		(d)	Voltage Ratio	As per Requirement
		(e)	Frequency	50 Hz
		(f)	Phase	Three (3)
		(g)	Service	Outdoor
		(h)	Duty	Continuous
		(i)	Overload capacity	As per IS: 6600/IEC60076-7 and specified elsewhere in the specification.
		(j)	Permissible Temperature rise over an ambient temp. of 50 deg. C	
		(1.)	Winding (by resistance method)	55 deg. C (45 deg.C for upto & including 2.5MVA and 33KV rating)
		(2.)	Top oil (by thermometer)	50 deg. C (40 deg.C for upto & including 2.5MVA and 33KV rating)
		(k)	Impedance at 75 deg.C	As per details of Transformers under "Key Technical Parameter-Transformers" Subsection/SLD/ As per sysytem requirement/specified elsewhere in the specification.
(l)	Noise Level	AS PER NEMA TR-1		
(m)	System fault level	As per requirement. However indicative min. values are: 36kV or Transformer fed from 33kV side –		
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-II-E12 OUTDOOR TRANSFORMERS	Page 1 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS						एनटीपीसी NTPC
			12.5kA 12kV or Transformer fed from 11kV side – 40kA 3.6kV or Transformer fed from 3.45kV side – 40kA 0.433kV – 50kA				
	(n) Winding						
	1.	Highest System Voltage(kV)	36	12	7.2	3.6	0.433
	2.	Lightning impulse withstand voltage, kVp	170	75	60	40	-
	3.	One min power frequency withstand voltage, kVrms	70	28	20	10	3
	4.	Insulation	uniform	uniform	uniform	uniform	uniform
	5. Method of neutral earthing and Vector group (Indicative only/As per system requirement):						
	KVA RATING	HV RATING (kV)	LV RATING (kV)	Vector Group	Method of Neutral Earthing		
	16,000	11	3.45	Dyn1	As per requirement		
	12,500	11	3.45	Dyn1	As per requirement		
2,000	11	0.433	Dyn1	LVN – Solidly Grounded.			
1,600	11	0.433	Dyn1	LVN – Solidly Grounded.			
1,000	11	0.433	Dyn1	LVN – Solidly Grounded.			
1,000	3.3	0.433	Dyn1	LVN – Solidly Grounded.			
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-II-E12 OUTDOOR TRANSFORMERS		Page 2 of 31	

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC																																		
(o) (p) (q)	<table><tr><th>KVA RATING</th><th>HV RATING (kV)</th><th>LV RATING (kV)</th><th>Vector Group</th><th>Method of Neutral Earthing</th></tr><tr><td>630</td><td>11</td><td>0.433</td><td>Dyn1</td><td>LVN – Solidly Grounded.</td></tr></table>					KVA RATING	HV RATING (kV)	LV RATING (kV)	Vector Group	Method of Neutral Earthing	630	11	0.433	Dyn1	LVN – Solidly Grounded.																								
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	630	11	0.433	Dyn1	LVN – Solidly Grounded.																																		
	Tap changer details:																																						
	i) Tap range		As per system requirement																																				
	ii) Tap Control		As per system requirement																																				
	Bushing CT Parameters (Indicative only)																																						
	<table><tr><th rowspan="2">SI NO.</th><th rowspan="2">Transformer Rating</th><th colspan="2">CT Parameters</th></tr><tr><th>Earth fault CT Class: 5P20</th><th>R.E.F.CT Class: PS</th></tr><tr><td>1.</td><td>16MVA, 11/3.45kV, Z=12.5%, Dyn1</td><td>600/1, Burden: 10 VA</td><td>3000/1A, RCT ≤ 15Ω, VK ≥450V, Im ≤ 30mA at VK/2</td></tr><tr><td>2.</td><td>12.5MVA, 11/3.45kV, Z=10%, Dyn1</td><td>600/1, Burden: 10 VA</td><td>2500/1A, RCT ≤ 12.5Ω, VK ≥450V, Im ≤ 30mA at VK/2</td></tr><tr><td>3.</td><td>2MVA, 11/0.433kV, Z=8%, Dyn1</td><td></td><td>3000/1A, RCT ≤ 15Ω, VK ≥450V, Im ≤ 30mA at VK/2</td></tr><tr><td>4.</td><td>1.6MVA, 11/0.433kV, Z=6.25%, Dyn1</td><td></td><td>2500/1A, RCT ≤ 12.5Ω, VK ≥450V, Im ≤ 30mA at VK/2</td></tr><tr><td>5.</td><td>1MVA, 11/0.433kV, Z=5%, Dyn1</td><td></td><td>1600/1A, RCT ≤ 8Ω, VK ≥450V, Im ≤ 30mA at VK/2</td></tr><tr><td>6.</td><td>1MVA, 3.3/0.433kV, Z=5%, Dyn1</td><td></td><td>1600/1A, RCT ≤ 8Ω, VK ≥450V, Im ≤ 30mA at VK/2</td></tr><tr><td>7.</td><td>630KVA, 11/0.433kV, Z=4%, Dyn1</td><td></td><td>1000/1A, RCT ≤ 5Ω, VK ≥450V, Im ≤ 30mA at VK/2</td></tr></table>					SI NO.	Transformer Rating	CT Parameters		Earth fault CT Class: 5P20	R.E.F.CT Class: PS	1.	16MVA, 11/3.45kV, Z=12.5%, Dyn1	600/1, Burden: 10 VA	3000/1A, RCT ≤ 15Ω, VK ≥450V, Im ≤ 30mA at VK/2	2.	12.5MVA, 11/3.45kV, Z=10%, Dyn1	600/1, Burden: 10 VA	2500/1A, RCT ≤ 12.5Ω, VK ≥450V, Im ≤ 30mA at VK/2	3.	2MVA, 11/0.433kV, Z=8%, Dyn1		3000/1A, RCT ≤ 15Ω, VK ≥450V, Im ≤ 30mA at VK/2	4.	1.6MVA, 11/0.433kV, Z=6.25%, Dyn1		2500/1A, RCT ≤ 12.5Ω, VK ≥450V, Im ≤ 30mA at VK/2	5.	1MVA, 11/0.433kV, Z=5%, Dyn1		1600/1A, RCT ≤ 8Ω, VK ≥450V, Im ≤ 30mA at VK/2	6.	1MVA, 3.3/0.433kV, Z=5%, Dyn1		1600/1A, RCT ≤ 8Ω, VK ≥450V, Im ≤ 30mA at VK/2	7.	630KVA, 11/0.433kV, Z=4%, Dyn1		1000/1A, RCT ≤ 5Ω, VK ≥450V, Im ≤ 30mA at VK/2
	SI NO.	Transformer Rating	CT Parameters																																				
			Earth fault CT Class: 5P20	R.E.F.CT Class: PS																																			
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3.	2MVA, 11/0.433kV, Z=8%, Dyn1		3000/1A, RCT ≤ 15Ω, VK ≥450V, Im ≤ 30mA at VK/2																																				
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5.	1MVA, 11/0.433kV, Z=5%, Dyn1		1600/1A, RCT ≤ 8Ω, VK ≥450V, Im ≤ 30mA at VK/2																																				
6.	1MVA, 3.3/0.433kV, Z=5%, Dyn1		1600/1A, RCT ≤ 8Ω, VK ≥450V, Im ≤ 30mA at VK/2																																				
7.	630KVA, 11/0.433kV, Z=4%, Dyn1		1000/1A, RCT ≤ 5Ω, VK ≥450V, Im ≤ 30mA at VK/2																																				
Bushing Parameters																																							
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-II-E12 OUTDOOR TRANSFORMERS	Page 3 of 31																																		

CLAUSE NO.	TECHNICAL REQUIREMENTS						एनटीपीसी NTPC
		Parameters	36 KV	12 KV	7.2KV	3.6kV	433 V
	(1 .)	Rated Voltage(kV)	36	12	7.2	3.6	1.1
	(2 .)	Lightning impulse withstand voltage, kVp	170	75	60	40	-
	(3 .)	One min power frequency withstand voltage , kV (rms)	77	30	22	11	3.0
	(4 .)	Minimum total creepage distances (mm)	25mm/kV x Rated Voltage of Bushing.				
	(5 .)	Mounting	Tank / Transformer body				
	(6 .)	Rated Current	As per details of Transformers under (r) Subsection.				
(r)	Bushing Rated Current (in Amperes)						
	SR. No.	KVA RATING	HV RATING (kV)	LV RATING (kV)	HV-Line	LV-Line	Neutral
	(1.)	16,000	11	3.45	1250	4000	4000
	(2.)	12,500	11	3.45	1250	3150	3150
	(3.)	2,000	11	0.433	250	3150	3150
	(4.)	1,600	11	0.433	250	3150	3150
	(5.)	1,000	11	0.433	250	2000	2000
	(6.)	1,000	3.3	0.433	250	2000	2000
	(7.)	630	11	0.433	250	1250	1250
(s)	Termination Details (Indicative only)						
	(1.)	HV Phase Terminal 33kV,11kV, 3.3kV	Cable box suitable for XLPE insulated cable.				
	(2.)	LV Phase Terminal 11.5 KV	Cable box/Busduct suitable for XLPE insulated cable.				
	(3.)	LV Phase Terminal 3.45 KV	Busduct (Non-Segregated)				
	(4.)	LV Phase Terminal 0.433KV	Busduct (Non-Segregated) Or Cable Box				
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-II-E12 OUTDOOR TRANSFORMERS		Page 4 of 31	

CLAUSE NO.		TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
(t)	(5.)	LV Neutral Terminal 3.45kV		Grounded through NGR		
	(6.)	LV Neutral Terminal 0.433kV		Solidily grounded through Copper flat connection.		
	XLPE Cable size (indicative/as per system requirement)					
	Sr. No.	KVA RATING	HV RATING (kV)	LV RATING (kV)	HV side	LV side
	(1.)	16,000	11	3.45	Cable	Bus duct
	(2.)	12,500	11	3.45	Cable	Bus duct
	(3.)	2,000	11	0.433	3 Cx150	Busduct
	(4.)	1,600	11	0.433	3 Cx150	Busduct/Cable
	(5.)	1,000	11	0.433	3 Cx150	Busduct/Cable
	(6.)	1,000	3.3	0.433	3 Cx150	Busduct/Cable
(7.)	630	11	0.433	3 Cx150	Cable	
(u)	Minimum Clearance in air (mm)					
	System voltage	33 kV	11 kV	6.6 kV	3.3 KV	433 V
	Phase to Phase	350	130	100	70	25
	Phase to Earth	320	120	90	60	25
1.02.00	NEUTRAL GROUNDING RESISTORS (INDICATIVE/AS PER SYSTEM REQUIREMENT)					
1.02.01	3.6 KV NGR					
	Sr. No	Parameters	3.6 kV			
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-II-E12 OUTDOOR TRANSFORMERS		Page 5 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
1.02.00 1.03.00	i) ii) iii) iv) v) vi) vii) viii)	Resistance Value at 50 deg. C. Rated current Service Resistor material & connection Maximum allowable temperature rise over ambient 50 oC Mounting Power frequency test level Application	3.32 Ohms 600A for 10 seconds Outdoor Punched stainless steel grid element type 350 deg. C 3.6 KV grade insulators. 10 KV (rms) Refer "Key Technical Parameter-Transformers" Subsection.
	Details of Transformers : As per system Requirement GENERAL STANDARDS All equipment provided under the specification shall in general, conform to the latest issue of the following standards:		
	Indian Standards No. IS: 2026, IS 1180 IS: 3639 IS: 2099 IS: 2705 IS: 325 IS: 3637 IS: 10028	Title Transformers Fittings & accessories for power transformers Insulating oils for transformer and switchgear Bushing for alternating voltages above 1000 V Current transformers Three phase induction motors Gas operated relays Code of practice for selection installation & maintenance of	International & internationally recognized standards IEC: 60076, IEC: 60296, BS:148 IEC: 60137, BS: 223 IEC: 60185 IEC: 60034
	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-II-E12 OUTDOOR TRANSFORMERS		Page 6 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	Indian Standards No.	Title	International & internationally recognized standards
		transformers	
	IS: 4691	Degree of protection provided by enclosure for rotating electrical machinery	
	IS: 13947	Specification for low voltage switchgear & control gear Part – I	IEC: 144
	IS : 5	Colours for ready mix paints	
	IS: 1866	Code of practice for maintenance & Supervision of mineral insulating oil in equipment	
	IS: 6272	Industrial cooling fans	
	IS: 6600	Guide for Loading of oil immersed transformers	IEC: 60076-7
	IS: 3347 IS:8603	Specification for dimensions of porcelain bushing	
	IS: 8468	Tap changers	IEC: 214
		High voltage test technique	IEC: 60
		Insulation co-ordination	IEC: 71
		NEMA standard publication for Power transformers	NEMA-TR-1
	IS: 10596	Code of practice for selection, Installation operation & maintenance of pumps for Industrial applications	
	IS: 9434	Guide for sampling & analysis of free & dissolved gas & oil from oil filled electrical equipment	IEC: 567
	IS: 2544	Porcelain post insulators for systems with nominal voltage greater than 1000 V	
	IS: 5561	Specification for electric power connectors	
	IS: 5621	Hollow insulators for use in electrical equipment	
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-II-E12 OUTDOOR TRANSFORMERS Page 7 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Indian Standards No.	Title	International & internationally recognized standards	
	IS: 2633	Methods for testing uniformity of coating of Zinc coated articles		
	IS: 12676	Dimensions for OIP insulated condenser bushings		
	BEE Guideline & CEA notification			
1.04.00	The electrical installation shall meet the requirements of Indian Electricity act 2003.			
2.00.00	PERFORMANCE			
(a)	The maximum flux density in any part of the core & yoke at the rated MVA, voltage & frequency shall be such that under 110% continuous voltage condition it does not exceed 1.9 Tesla.			
(b)	The transformer & all its accessories including CT's etc, shall be designed to withstand without injury the thermal & mechanical effects of any external short circuit to earth & of short circuits at the terminal of any winding for a period of 2 sec.			
(c)	Transformers shall withstand, without injurious heating, combined voltage & frequency fluctuations, which produce the following over fluxing condition:			
	1)	110 %- continuous		
		125%- for one minute		
		140%- for five seconds		
	2)	Bidder shall indicate 150% & 170% over voltage withstand time.		
	3)	Over fluxing characteristics up to 170 % shall be submitted.		
(d)	The transformers shall be capable of being operated continuously without danger on any tapping at the rated MVA with voltage variation of ±10% corresponding to the voltage of tapping.			
(e)	The transformers shall be capable of being loaded in accordance with IS: 6600 / IEC: 60076-7 up to load of 150 %. There shall be no limitation imposed by bushings, tap changers etc. or any other associated equipment.			
(f)	Outdoor transformers shall have energy efficiency level 3 as per IS 1180.			
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-II-E12 OUTDOOR TRANSFORMERS Page 8 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			एन टी पी सी NTPC
(h)	The main tank body shall be capable of withstanding full vacuum.			
3.02.00	Core			
(a)	The core shall be constructed from cold rolled, super grain oriented (CRGO), silicon steel laminations of equivalent to M4 or better grade.			
(b)	The core isolation level shall be 2 kV (rms.) for 1 minute in air.			
(c)	Adequate lifting lugs will be provided to enable the core & windings to be lifted.			
3.03.00	Windings			
(a)	The contractor shall ensure that windings of all transformers are made in dust proof & conditioned atmosphere. The bidder shall furnish details of the facilities available at his works along with the Techno- Commercial bid.			
(b)	The conductors shall be of electrolytic grade copper free from scales & burrs.			
(c)	All windings of the transformers having voltage less than 66 kV shall be fully insulated.			
(d)	Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratio.			
3.04.00	Insulating Oil			
	No inhibitors shall be used in the transformer oil. The oil supplied with transformers shall be new and previously unused and must conform to following while tested at supplier's premises and shall have following parameters.			
	S.No.	Property	Permissible values	
	1.	Kinematic Viscosity, mm ² /s	≤ 12 at 40 ° C ≤ 1800.0 at (-)30 ° C	
	2.	Flash Point, ° C	≥ 140° C	
	3.	Pour point, ° C	≤ (-)40 ° C	
	4.	Appearance	Clear , free from sediment and suspended matter	
	5.	Density kg/dm ³ at 20 ° C	≤ 0.895	
	6.	Interfacial Tension N/m at 25° C	≥ 0.04	
	7.	Neutralisation value, mgKOH/g	≤ 0.01	
	8.	Corrosive sulphur	Non Corrosive	
	9.	Water content mg/kg	≤ 30 in bulk supply ≤ 40 in drum supply	
	10.	Anti oxidants additives	Not detectable	
	11.	Oxidation Stability		
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-II-E12 OUTDOOR TRANSFORMERS
Page 10 of 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	S.No.	Property	Permissible values	
		Neutralization value, mgKOH/g	≤ 1.2	
		Sludge, % by mass	≤ 0.8	
	12.	Breakdown voltage As delivered, kV After treatment, kV	≥ 30 ≥ 70	
	13.	Dissipation factor, at 90° C And 40 Hz to 60 Hz	≤ 0.005	
	14.	PCA content	≤1%	
	15.	Impulse withstand Level, kVp	≥ 145	
	16.	Gassing tendency at 50 Hz after 120 min, mm ³ /min	≤ 5	
	Subsequently oil samples shall be drawn at:			
	(a)	After placement of transformer on foundation, Oil of main tank shall be tested for		
	i)	BDV	60 kV (min)	Applicable for all transformers including 16 MVA.
	ii)	Moisture content	10 ppm (max.)	
	iii)	Tan delta at 90 deg. C	0.002 (max.)	Applicable for 16 MVA & above Transformers only.
	iv)	Resistivity at 90 deg. C	35 x 10 ¹² ohm-cm (min)	
	v)	Interfacial tension	0.040 N/m (min)	
(b)	Prior to energization at site for following properties & acceptance norms:			
	i)	BDV	60 kV (min)	Applicable for all transformers including 16 MVA.
	ii)	Moisture content	10 ppm (max.)	
	iii)	Tan delta at 90 deg. C	0.05 (max.)	Applicable for 16 MVA & above Transformers only.
	iv)	Resistivity at 90 deg. C	1 x 10 ¹² ohm-cm (min)	
	v)	Interfacial tension	0.035 N/m (min)	
3.04.02	Oil Preservations System			
(a)	The transformers rated below 7.5 MVA shall have the following types of oil preservation systems: (i.) Conventional Conservator			
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-II-E12 OUTDOOR TRANSFORMERS
Page 11 of 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	The transformer shall be provided with conventional single compartment conservator with dry air filling the space above the oil. The top of the conservator shall be connected to the atmosphere through a cobalt free indicating type silica gel breather with transparent enclosure. The Buchholz relay shall also be provided. The conservator shall be fitted with a cobalt free non-carcinogenic indicating type silica gel filter breather of transparent enclosure breather, which shall be so designed that: → Passage of air is through a dust filter and silica gel. → Silica gel is isolated from atmosphere by an oil seal. → Moisture absorption indicated by a change in colour of the tinted crystal can be easily observed from a distance. → Breather is mounted not more than 1400 mm above rail top level.				
	(b)	For transformers rated 7.5 MVA and above, bidder shall offer air cell type oil sealing in the conservator to prevent oxidation and contamination of oil due to contact with water. The requirement of air cell type constant oil preservation system are given below: i. Contact of the oil with atmosphere is prohibited by using a flexible urethane or nitrile rubber reinforced with nylon cloth air cell. ii. The connection of air cell to the top of reservoir is by air proof seal preventing entrance of air into the conservator. iii. The temperature is likely to rise upto 100 Deg C when the transformer is in operation. As such air cell used shall be suitable for operating continuously at 100 deg. C. iv. A silica gel breather shall be provided in the air side vent line.			
	3.05.00	Terminal Arrangements			
	3.05.01	Bushings			
	(a)	The electrical & mechanical characteristics of bushings shall be in accordance with IS: 2099, IS: 3347 & IS: 12676. Bushings of rating below 52 kV shall be solid porcelain/oil communicating/condenser type. All condenser bushings shall be non-communicating type.			
	(b)	Condenser type bushings shall be provided with : (i.) Oil level gauge, (ii.) Oil filling plug & drain valve (if not hermetically sealed) (iii.) Tap for capacitance & tan delta test.			
	(c)	Clamps & fittings shall be of hot dip galvanized steel.			
	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-II-E12 OUTDOOR TRANSFORMERS	Page 12 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS		
(d)	Bushing & fittings shall be provided with vent pipes that shall be connected to route any gas collection through the Buchholz relay.		
(e)	No arcing horns shall be provided on the bushings.		
(f)	Wherever cable termination is specified, bushing terminals shall be provided with suitable terminal connectors of approved type and size for cable termination.		
(g)	Where current transformers are specified, the bushings shall be removable without disturbing the current transformer.		
3.05.02	Neutral Terminal Arrangement		
3.05.03	Neutral Termination		
(a)	The neutral terminal of 433 V winding shall be brought out on a bushing along with the 433 V phase terminal to form a 4 wire system for the 433 V. Neutral CT's shall be located in the lead coming out of the winding and location of these CT's shall not be inside the tank.		
(b)	The neutral terminal of winding not connected to NGR (as per "Key Technical Parameter-Transformers" Subsections), shall also be brought out through an outdoor bushing. Further this neutral terminal shall be connected by a copper flat of size 50 mm x 8 mm, which shall be brought down upto 100 mm above ground. The copper flat shall be insulated and supported from the tank body. The connection shall be made by using two (2) bolted neutral grounding terminals with necessary accessories.		
(c)	The neutral terminal of winding connected to NGR (as per "Key Technical Parameter-Transformers" Subsections), shall be brought to an outdoor bushing, away from the busduct termination arrangement (wherever applicable). It shall be connected to associated neutral grounding resistor by a copper flat, which shall be supplied & installed by the contractor along with the necessary intermediate supporting insulators & supporting structure. Also NGR shall be grounded through copper flat which shall be insulated and properly supported and shall be brought down upto 100 mm above ground.		
3.05.04	Bus Duct Terminations		
(a)	A flanged throat or equivalent connection shall be provided for termination of busduct enclosure. The winding termination shall be on outdoor type of bushings. The Employer would provide necessary flexible connection between the bushing terminal & the bus duct conductor. The material of the busduct termination shall be non-magnetic.		
(b)	The shape of the bus duct conductor shall be informed during detailed engineering. The bushing pads shall be silver/tin plated. A drain with stopcock arrangement shall be provided at flange to drain leakage of oil/water at termination. As bus duct will be pressurized stopcocks shall be airtight.		
(c)	Tolerance permissible for the height of the terminal connected to busduct over rail top level is ± 10 mm. Contractor has to ensure that radiator & conservator does not		
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-II-E12 OUTDOOR TRANSFORMERS
			Page 13 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	obstruct the path of the bus ducts in position & during movement of transformer. The contractor shall co-ordinate final design of terminal arrangement to suit bus duct arrangement during detailed engineering.			
(d)	The transformer bushing enclosed in bus duct enclosure shall be designed for satisfactory operation in the high ambient temperature existing inside the bus duct enclosure. The temperature inside the bus duct enclosure may be of the order of 90 – 100 deg. C. The bus duct conductor temperature may be as high as 105 deg C & temperature in the bus duct enclosure will be of the order of 80 deg. C.			
3.05.05	Cable boxes & disconnecting chamber			
(a)	HV Cable boxes shall be of phase segregated air insulated type & shall be of sufficient size to accommodate Employer's cable & termination (as applicable). Phase segregation shall be achieved by insulating barriers.			
(b)	Cable boxes shall have bus bars / terminal connectors of adequate size & bolt holes to receive cable lugs.			
(c)	A suitable removable gland plate of non-magnetic material drilled as per the Employer's instruction shall also be provided in the cable box.			
(d)	The support from base for the cable box shall be of galvanized iron.			
(e)	The contractor shall provide earthing terminals on the cable box, to suit Employer's GI flat.			
(f)	The final cable size & type, number & length of terminating cable (from cable gland plate to the cable lug) shall be furnished during detailed engg.			
(g)	Cable boxes shall be designed such that it shall be possible to move away the transformer without disturbing the cable terminations, leaving the cable box on external supports.			
(h)	Cable boxes shall have removable top cover & ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.			
3.05.06	TERMINAL CONNECTOR (If applicable)			
(a)	Bushing terminal shall be provided with terminal connectors of approved type & size for connection to external part. Terminal connectors must have been successfully type tested as per IS: 5561.			
(b)	Aluminium alloy if used shall conform to designation 4600 M of IS: 617 or of better quality.			
(c)	No current carrying part of a clamp shall be less than 10 mm thick.			
(d)	All ferrous parts shall be hot dip galvanized conforming to IS: 2633.			
(e)	For bi-metallic clamp, copper alloy liner of minimum 2-mm thickness shall be cast integral with aluminum body. Alternatively Bidder may offer bimetallic connector with loose bimetallic sleeve.			
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-II-E12 OUTDOOR TRANSFORMERS
Page 14 of 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
(f)	Flexible connectors shall be made from tinned copper sheets.			
(g)	Size of terminal/conductor for which the clamp is suitable & rated current under the conditions shall be embossed / punched on each component of the clamp, except hardware.			
(h)	Rated current of the terminal connectors shall be same as that of corresponding bushing.			
3.06.00	Bushing Current Transformer			
(a)	Current transformer shall comply with IS: 2705.			
(b)	It shall be possible to remove turret mounted current transformers from the transformer tank without removing the tank cover. Necessary precautions shall be taken to minimize eddy currents & local heat generated in the turret.			
(c)	All secondary leads shall be brought to a weatherproof terminal box near each bushing. These terminals shall be wired out to transformer marshalling box using separate cables for each core.			
3.07.00	Terminal Marking			
	The terminal marking & their physical position shall be as per IS: 2026 unless specified otherwise.			
3.08.00	Marshalling Box(M. BOX) Unit			
(a)	Each transformer shall be provided with one Marshalling Box housing all the cooler control, OTI & WTI etc. M. Box shall be of stainless steel (SS-316 or better), at least 2.5 mm thick, dust and vermin proof provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. Marshalling Box of all transformers shall be preferably Tank Mounted. The gasket used shall be of neoprene rubber. A space heater & cubicle lighting with on-off switch shall be provided in each cabinet. A circuit breaker/contactors with thermal overload device for controlling the AC auxiliary supply shall be provided.			
(b)	Terminal Blocks			
	(1.) The terminal blocks to be provided shall be fully enclosed with removable covers & made of molded, non-inflammable plastic material with blocks & barriers molded integrally. The terminal blocks shall be of 650V grade & have 10 A continuous rating. Terminal blocks for current transformer secondary leads shall be provided with test links & isolating facilities. Also current transformer secondary leads shall be provided with short circuiting & earthing facilities. At least 20% spare terminals shall be provided on each panel & these spare terminals shall be uniformly distributed on all terminal blocks. (2.) Terminal blocks shall be suitable for connecting the following conductors on each side : (i.) Current transformer circuits – minimum of two No. of 2.5 sq. mm copper wires each side			
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-II-E12 OUTDOOR TRANSFORMERS
Page 15 of 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC						
	(ii.) Other circuits— minimum of one No. of 2.5 sq. mm copper wire each side (iii.) Terminal blocks numbering shall be made inline with the tender drawing no. 0000-203-PVE-B-001 (Title: “Standard Terminal Numbers for Marshalling Box of all Transformers”) enclosed (c) The temperature indicators shall be so mounted that the dials are not more than 1500 mm from ground level. Glazed door of suitable size shall be provided for convenience of reading. (d) All incoming cables shall enter the marshalling box from the bottom. A removable undrilled gland plate shall be provided at the bottom of the box for accommodating glands for Employer’s incoming and outgoing cables, which shall not be less than 450 mm from finished floor level. (e) All devices and terminal blocks inside the marshalling box shall be clearly identified by symbols corresponding to those used on applicable schematic or wiring diagram. (f) It shall be located in such a way that, the same shall not face towards the transformer. (g) The gland plate shall be made into two detachable halves, for facilitating the termination of Employer’s cable and Contractor’s cables separately. The gland plate and the associated compartment shall be sealed in a suitable manner to prevent the ingress to moisture, rodents, insects etc. (h) One dummy terminal block in between each trip wire terminal shall be provided. (i) Wiring Scheme shall be engraved in a plate and the same shall be fixed inside the Marshalling Box door.									
3.09.00	Control Wiring & Cabling Supply, laying & termination of all cables & accessories required of proper termination from the M. Box except for those stated under next clause below so as to make equipment complete & functional shall be in scope of supplier. The cable between the M. Box & transformer shall be laid by the supplier through GI conduits/ pipes. Cable box / sealing end shall be suitable for following types of cables <table><tr><td>1)</td><td>415 V power</td><td>1100 V grade PVC insulated aluminum conductor cable with armour.</td></tr><tr><td>2)</td><td>Control</td><td>1100 V grade PVC insulated 2.5 sq. mm stranded copper conductor with armour.</td></tr></table>				1)	415 V power	1100 V grade PVC insulated aluminum conductor cable with armour.	2)	Control	1100 V grade PVC insulated 2.5 sq. mm stranded copper conductor with armour.
1)	415 V power	1100 V grade PVC insulated aluminum conductor cable with armour.								
2)	Control	1100 V grade PVC insulated 2.5 sq. mm stranded copper conductor with armour.								
3.10.00	PAINTING Painting of transformer and its accessories shall be in accordance with the following chart.									
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-II-E12 OUTDOOR TRANSFORMERS	Page 16 of 31						

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC				
		PARTS NAME	TYPE OF PAINT	No.of Coats	Total DFT
	(1.)	Inside of tank and accessories (except M Box)	Oil & heat resistant fully glossy white	One coat	Atleast 30 micron
	(2.)	External surface of transformer and accessories (except radiator)	Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint of blue colour corresponding to RAL 5012.	One coat each	Atleast 100 micron
	(3.)	External radiator surface	Anticorrosive primary paint followed by high quality full glossy outer finish paint (blue colour corresponding to RAL 5012.)	Two coats each	Atleast 100 micron
	(4.)	Internal radiator surface	Hot oil proof, low viscosity varnish and subsequent flushing with transformer oil		
3.11.00	Cooling Equipment The radiators shall be detachable type, mounted on the tank. Each radiator shall be provided with the following: (a) A drain plug at the bottom. (b) An air release plug at the top.				
3.12.00	TAP CHANGER DEVICE				
3.12.01	Off Circuit Tap change Switch (a) The tap change switch shall be three phase, hand operated for simultaneous switching of similar taps on the three phases by operating on external hand wheel. (b) The tap changing shall be possible without disturbing the transformer in any way except de-energising. (c) Arrangement shall be made for securing and pad-locking the tap changer in any of the working positions, and it shall not be possible for setting or padlocking it in any intermediate position. An indicating device shall be provided to show the tap in use. (d) The Cranking device for manual operation of the off circuit tap changing gear shall be removable and suitable for operation by a man standing on ground level. The mechanism shall be complete with the following:-				
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-II-E12 OUTDOOR TRANSFORMERS	Page 17 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	(i.) Mechanical tap position indicator which shall be clearly visible from near the transformer. (ii.) Mechanical stops to prevent over cranking of the mechanism beyond the extreme tap positions. (iii.) The manual operating mechanism shall be labeled to show direction of operation for raising the secondary voltage and vice versa. (iv.) A warning plate indicating “The switch shall be operated only when the transformer has been de-energised” shall be fitted.	
3.13.00	VALVES (a) All valves upto and including 50 mm shall be of gun metal or of cast steel. Larger valves may be of gun metal or may have cast iron bodies with gun metal fittings. They shall be of full way type with internal screw and shall open when turned counter clockwise when facing the hand wheel. (b) Suitable means shall be provided for locking the valves in the open and close positions. Provision is not required for locking individual radiator valves. (c) Each valve shall be provided with the indicator to show clearly the position of the valve. (d) Gland packing/gasket material shall be of teflon rope/nitrile rubber. In case of gate/globe valves, gland packing preferably of teflon rope shall be used to prevent oil seepage through the gland. (e) After testing, inside surface of all cast iron valves coming in contact with oil shall be applied with one coat of oil resisting paint/varnish with two coats of red oxide zinc chromate primer followed by two coats of fully glossy finishing paint conforming to IS:2932 and of a shade (Preferably red or yellow) distinct and different from that of main tank surface. Outside surface except gasket setting surface of butterfly valves shall be painted with two coats of red oxide zinc chromate conforming to IS:2074 followed by two coats of fully glossy finishing paint. (f) All hardware used shall be cadmium plated/electro galvanised. (g) Sampling & drain valves should have zero leakage rate.	
3.14.00	Neutral Grounding Resistors (If applicable) The earthing resistors are required for LV neutral point earthing of the various transformers. (as specified elsewhere in this specification) (a) Resistor Elements The resistors shall be of punched stainless steel grid element type. The grids shall be securely supported at sufficient number of points so that no damage is caused to the grids due to vibrations and no mechanical stresses are developed. The resistor element shall be insulated from supporting base by	
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-II-E12 OUTDOOR TRANSFORMERS
		Page 18 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	mica tubes. The insulating material used in the construction shall be heat resistant such as mica. (b) Stacking Various sections comprising the neutral grounding resistor shall be capable of being stacked one above the other. The insulators supporting the resistor assemblies shall be of outdoor type. Connecting links shall be provided to connect adjacent stacks. (c) Enclosure The neutral grounding resistor shall be housed in a 2.5 mm thick sheet steel enclosure. The enclosure shall be weather proof having IP 33 degree of protection in accordance with IS: 13947. The resistor neutral side terminal shall be brought out on the roof and the ground side terminal at the side of the enclosure through porcelain bushings. The ground side terminal shall be brought to ground level by a copper flat supported from the mounting structure by porcelain insulators. The copper bar shall have two (2) bolted neutral grounding terminals with hole size suitable for M10 bolt size and necessary accessories for connecting to ground mat through two MS 'flats'. The enclosure shall be supported on insulators placed on the mounting structure. (d) Mounting Structure The Contractor shall supply and erect a galvanized structure to support the NG resistor enclosure so that the base of the enclosure shall be at a minimum height of 2.4M above ground level. The NG resistor enclosure mounting and the neutral connection shall be such that it does not obstruct the busduct routing in any way. A heating circuit with Thermostat to be provided inside the enclosure to control humidity. 3.15.00 Bolts & Nuts All bolts & nuts exposed to weather shall be hot dip galvanised steel /cadmium plated steel. 3.16.00 Gasket The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. Supplier shall also recommend quality & make of gaskets to be used for replacement during maintenance if required. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer. The quality of these joints is considered established, only if the joints do not exhibit any oil leakage or sweating for a continuous period of at least 3 months during the guarantee period. In case any sweating / leakage is observed, contractor shall rectify the same & establish for a further period of 3 months of the same. If it is not established during the		
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-II-E12 OUTDOOR TRANSFORMERS	Page 19 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	guaranteed period, the guaranteed period shall be extended until the performance is established.			
4.00.00	FITTINGS			
4.01.00	The following fittings shall be provided with each transformer covered in this specification:			
	1) Conservator for main tank with oil filling hole and cap, isolating valves, drain valve, magnetic oil level gauge with low level alarm contacts and dehydrating cobalt free non-carcinogenic indicating type silica gel breather with transparent enclosure. Breather for conservators shall be mounted not more than 1400 mm above rail top. 2) Oil preservation system: - as specified elsewhere. 3) Minimum two Nos. of spring operated pressure relief devices with alarm/trip contacts for transformer of 2 MVA & above rating. Discharge of PRD shall be properly taken through pipes & directed away from the transformer /other equipment. 4) Buchholz relay double float type with isolating valves on both sides, bleeding pipe with Gas collecting device at the end to collect gases and alarm and trip contacts. Control cable termination at Buchhloz relay shall be properly sealed to prevent water entry. 5) Air release plug. 6) Inspection openings and covers. 7) Bushing with metal parts and gaskets to suit the termination arrangement. 8) Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs. 9) Protected type Mercury or alcohol in glass thermometer. 10) Bottom and top filter valves with threaded male adapters, bottom Sampling valve & drain valve. 11) Rating and diagram plates on transformers (English & Hindi) and auxiliary apparatus. 12) Radiator as specified. 13) Prismatic/toughened glass oil gauge for transformers. 14) 150 mm dial type oil temp indicator with alarm and trip contacts, maximum reading pointer & resetting device. Accuracy class shall be ± 1.5 % or better. 15) 150-mm dial type Winding temp indicator with alarm and trip contacts, maximum reading pointer & resetting device. Accuracy class shall be ± 1.5 % or better. 16) Flanged bi-directional wheels. 17) Marshalling Box. 18) Off load tap changing gear 19) Cooling equipment. 20) Bushing current transformers. 21) Insulating oil.			
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-II-E12 OUTDOOR TRANSFORMERS	Page 20 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.02.00	22)	Drain valves/plugs shall be provided in order that each section of pipe work can be drained independently. Sludge valve at bottom most point of tank to be provided for easy flush out/removal of sludge during maintenance.		
	23)	Terminal marking plates.		
5.00.00	24)	Valves schedule plates.		
	25)	Two (2) earthing terminals on all the equipment mounted separately suitable for connection to suitable GI flat along with 2 Nos. tapped holes. M10 bolts etc.		
	26)	Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed.		
	The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformer, are deemed to be included.			
5.00.01	INSPECTION AND TESTING			
	For Transformers above 2MVA ratings			
(a)	The Contractor shall carry out a comprehensive inspection and testing program during manufacture of the transformer. The owner may waive conduction of any test subject to availability of test facility. An indication of inspection envisaged by the Employer is given elsewhere in the specification. This is however not intended to form a comprehensive program, as it is Contractor's responsibility to draw up and carry out such a program in the form of detailed quality plan duly approved by Employer for necessary implementation.			
(b)	The Contractor shall carry out all type tests and routine tests on each type/rating of transformers. The tests are listed elsewhere in the specification.			
(c)	The bidder shall indicate the charges for each of these type tests separately in the Techno- Commercial bid 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.			
(d)	The equipment checks to be carried out by the Contractor are given elsewhere in the specification.			
(e)	The requirements of site tests are given elsewhere in the specification.			
(f)	The makes of all major bought out items shall be subjected to Employer's approval. The contractor shall also prepare a comprehensive inspection and testing program for all bought out/sub-contracted items and shall submit the same to Employer.			
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-II-E12 OUTDOOR TRANSFORMERS
Page 21 of 31				

CLAUSE NO.	TECHNICAL REQUIREMENTS	
(g)	Each transformer shall be completely assembled with all fittings and accessories meant for the particular transformer before offering for inspection and testing by Employer.	
(h)	The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.	
(i)	In case the contractor has conducted such specified type test(s) not earlier than ten years as on the date of Techno- Commercial bid opening, he may submit during detailed engineering the type test reports to the owner for waiver of conductance of such type 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 owner reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.	
(j)	Following components to be supplied shall be of tested design. During detailed engineering, the contractor shall submit for employer's approval the reports of all the type tests as listed below in specification and carried out within last ten years from the date of Techno- Commercial bid opening. The 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 witness by a client. However if the contractor is not able to submit report of the type test(s) conducted within last ten years from date of Techno- Commercial bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the employer either at third party lab or in presence of client/employer's representative and submit the reports for approval. (a) Tank Pressure and Vacuum test (b) Neutral Grounding Resistor (NGR)	
(k)	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.	
5.00.02	For Transformers of rating 2MVA and below a) All equipments to be supplied shall be of type tested design. During detailed engineering, 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 test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have	
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-II-E12 OUTDOOR TRANSFORMERS
		Page 22 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																																																						
	been either conducted at an independent laboratory or should have been witnessed by a client. b) However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client /Employers representative and submit the reports for approval. c) 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. d) 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. Type and Routine tests Routine Tests <table><tr><th>Sr. No.</th><th>Routine Tests</th><th>OIL FILLED OUTDOOR TRANSFORMER</th></tr><tr><td>1</td><td>All routine test in accordance with IEC 60076 shall be carried out in all the transformers.</td><td>√</td></tr><tr><td>2</td><td>Measurement of Voltage Ratio</td><td>√</td></tr><tr><td>3</td><td>Measurement of winding resistance on HV & LV on all the taps (as per IEC 60076-1)</td><td>√</td></tr><tr><td>4</td><td>Vector group and Polarity Check (as per IEC 60076-1)</td><td>√</td></tr><tr><td>5</td><td>Magnetic Balance Test</td><td>√</td></tr><tr><td>6</td><td>Measurement of no load current with 415 V, 50 Hz AC supply</td><td>√</td></tr><tr><td>7</td><td>Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)</td><td>√</td></tr><tr><td>8</td><td>Impedance & Load Loss Measurement on principal, Max & Min. Taps</td><td>√</td></tr><tr><td>9</td><td>IR measurement (As per IEC 60076-1)</td><td>√</td></tr><tr><td>10</td><td>Dielectric tests shall be carried out as per IEC 60076-3.</td><td>√</td></tr><tr><td>11</td><td>Separate Source Voltage Withstand Test (As per IEC 60076-3)</td><td>√</td></tr><tr><td>12</td><td>Induced Over Voltage Withstand test as per IEC 60076-3</td><td>√</td></tr><tr><td>13</td><td>Repeat no load current/loss measurement & IR measurement after completion of all dielectric test</td><td>√</td></tr><tr><td>14</td><td>Measurement of capacitance & tan delta to determine capacitance between winding & earth. (As per IEC 60076-1),also see note (iv)</td><td>√</td></tr><tr><td>15</td><td>Oil leakage test</td><td>√</td></tr><tr><td>16</td><td>Jacking test followed by D.P. test</td><td>√</td></tr><tr><td>17</td><td>Marshalling Box/Cable box: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.</td><td>√</td></tr></table>				Sr. No.	Routine Tests	OIL FILLED OUTDOOR TRANSFORMER	1	All routine test in accordance with IEC 60076 shall be carried out in all the transformers.	√	2	Measurement of Voltage Ratio	√	3	Measurement of winding resistance on HV & LV on all the taps (as per IEC 60076-1)	√	4	Vector group and Polarity Check (as per IEC 60076-1)	√	5	Magnetic Balance Test	√	6	Measurement of no load current with 415 V, 50 Hz AC supply	√	7	Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)	√	8	Impedance & Load Loss Measurement on principal, Max & Min. Taps	√	9	IR measurement (As per IEC 60076-1)	√	10	Dielectric tests shall be carried out as per IEC 60076-3.	√	11	Separate Source Voltage Withstand Test (As per IEC 60076-3)	√	12	Induced Over Voltage Withstand test as per IEC 60076-3	√	13	Repeat no load current/loss measurement & IR measurement after completion of all dielectric test	√	14	Measurement of capacitance & tan delta to determine capacitance between winding & earth. (As per IEC 60076-1),also see note (iv)	√	15	Oil leakage test	√	16	Jacking test followed by D.P. test	√	17	Marshalling Box/Cable box: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.	√
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CLAUSE NO.		TECHNICAL REQUIREMENTS		
Sr. No.		Routine Tests	OIL FILLED OUTDOOR TRANSFORMER	
18		IR measurement on wiring of Marshalling Box.	√	
		Type Tests		
19		Dynamic Short circuit test (special test) as per IEC 60076-5.	√	
20		Temp. rise test at a tap corresponding to maximum losses. DGA shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599).	√	
21		Lightning impulse (Full & Chopped Wave) test on windings	√	
22		Lightning impulse test on Neutral	√ (refer note iii)	
24		Measurement of acoustic noise level as per NEMA TR-1 (special test)	√	
Note: i) (√) mark indicates that the test to be carried out. (x) mark indicates that the test need not be carried out. ii) All the type tests shall be conducted after short circuit test. If Tank Vacuum & Pressure Test is to be carried out then it shall be conducted before SC test. iii) Applicable on transformer neutral connected with NGR. iv) For outdoor transformer the limiting value of tan delta shall be 1.0% @ 20 deg C.				
5.01.02		Type tests on Components Type test reports shall be submitted for following:		
	(a)	Tank Vacuum & Pressure Test		
	(b)	Neutral Grounding resistors		
5.02.00		TANK TEST		
	(a)	Routine test (1.) Oil leakage test on assembled transformer All tank & oil filled compartment shall be tested for oil tightness by being completely filled with oil of viscosity not greater than that of specified oil at the ambient temperature & applying pressure equal to the normal pressure plus 35 KN/sq. m measured at the base of the tank. The pressure shall be maintained for a period of not less than 6 hours during which time no sweating shall occur. This test shall be done on completely assembled transformer.		
	(b)	Type Tests		
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-II-E12 OUTDOOR TRANSFORMERS	Page 24 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
5.03.00	(1.) Vacuum Test Each type of transformer tank shall be subjected to the vacuum test as per CBIP norms. (2.) Pressure Test Transformer tank of each type shall be subjected to a pressure test as per CBIP norms. NGR Testing (a) The following routine tests shall be conducted on each resistor covered in this package. (1.) Ohmic resistance value measurement Insulation resistance measurement before & after HV test (2.) HV test for 1 min. at a voltage corresponding to the insulation level of the resistor. (b) DOP test on enclosure (routine test) as follows. It shall not be possible to insert a 2.5mm dia. steel wire into the enclosure from any direction without using force. <u>Type tests</u> Type test reports shall be submitted for following: (a) Short time current test along with temperature rise test. (b) Degree of protection test for IPX3.		
5.04.00	Pre-shipment Checks at Manufacture's Works (a) Check for interchangeability of similar transformers for mounting dimensions. (b) Check for proper packing and reservation of accessories like radiators, bushings, dehydrating breather, rollers, Buchhloz relay, fans, control cubicle, connecting pipes, conservator etc. (c) Check for proper provision for bracing to arrest the movement of core and winding assembly inside the tank.		
5.05.00	Inspection and Testing at Site The Contractor shall carry out a detailed inspection and testing program for field activities covering areas right from the receipt of material stage up to commissioning stage. An indicative program of inspection as envisaged by the Employer is given below. This is however not intended to form comprehensive program, as it is contractor's responsibility to draw up and carry out such a program duly approved by the Employer. Testing of oil sample at site shall be carried out as specified elsewhere in this specification.		
5.05.01	Receipt and Storage Checks		
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-II-E12 OUTDOOR TRANSFORMERS	Page 25 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Following checks as detailed out in finalized/agreed FQP shall be followed.			
(a)	Check and record condition of each package, visible parts of the transformer etc. for any damage.			
(b)	Visual check for wedging of core and coils before filling up with oil and also check conditions of core and winding in general, if transformer filled with N2/dry air.			
5.05.02	Installation Checks			
(a)	Inspection and performance testing of accessories like tap changers etc.			
(b)	Check whole assembly for tightness, general appearance etc.			
(c)	Check oil sample.			
(d)	Leakage test on bushing before erection, if bushing is transported separately.			
(e)	Capacitance & tan delta measurement of condenser bushing before fixing / connecting to the winding, contractor shall furnish these values for site reference.			
5.05.03	Commissioning Checks			
(a)	Check the colour of silica gel in silicagel breather.			
(b)	Check the oil level in the breather housing, conservator tanks, cooling system, condenser-bushing etc.			
(c)	Check the bushing for conformity of connection to the lines etc. and tan delta test for bushing.			
(d)	Check for correct operation of protection devices and alarms: (i.) Buchhloz relay. (ii.) Excessive winding temperature (iii.) Excessive oil temperature (iv.) Low oil level indication (v.) Pressure relief valve			
(e)	Check for the adequate protection on the electric circuit supplying the accessories.			
(f)	Check resistance of all windings on all steps of the tap changer.			
(g)	Insulation resistance measurement for the following: (i.) Control wiring. (ii.) Main windings			
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-II-E12 OUTDOOR TRANSFORMERS	Page 26 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(iii.) Tank & turret mounted CT's (h) Check for cleanliness of the transformer and the surroundings. (i) Check the following (i.) Buchholz, oil level indicator, pressure gauges, temp indicators etc. for fitting & operation. (ii.) Earthing of main tank, marshaling Box, tap changer driving gear, cable box, fan motor etc. (iii.) Neutral earthing (iv.) Calibration of WTI and OTI (v.) Earthing of bushing test tap (vi.) Connection of WTI CT with its heater (vii.) Tightness of CT secondary connection and shorting of unused CTs (viii.) All valves for their correct opening and close sequence (j) Phase out and vector group test. (k) Ratio test on all taps. (l) Magnetizing current test (HV winding & LV winding). (m) Capacitance and Tan delta measurement of winding (n) Oil Dielectric strength test-the various test on oil shall be conducted prior to filling in main tank at site & prior to energization at site as specified elsewhere in this specification. Oil samples are to be drawn from top & bottom of main tank & cooling system. (o) DGA of oil before commissioning (p) Magnetic balance test (q) Short circuit impedance measurement (r) Test on tank/turret mounted CT's (i.) IR value between secondary winding & earth and between windings (ii.) Secondary resistance (iii.) Polarity (iv.) Ratio test (v.) Magnetization current (s) WTI and OTI setting for alarm/trip, fan start/stop (if applicable) and pump start/stop (if applicable). (t) Final IR Value (i.) HV/E+LV (ii.) LV/E+HV (iii.) HV/LV (u) Continuously observe the transformer operation at no load for 24 hrs. w.r.t. Voltage, no load current, temperature rise and noise.			
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-II-E12 OUTDOOR TRANSFORMERS	Page 27 of 31

CLAUSE NO.	TECHNICAL REQUIREMENTS			
(v)	Gradually put the transformer on load, check and measure increase in temperature in relation to the load and check the operation with respect to temperature rise and noise level etc.			
6.00.00	BIDDER MAY REFER ENCLOSED STANDARD TENDER DRAWINGS AS MENTIONED BELOW FOR LT OUTDOOR TRANSFORMERS UPTO AND INCLUDING 2 MVA RATING WITH APPROPRIATE PRIMARY AND SECONDARY VOLTAGE LEVEL (AS MENTIONED IN THE DRAWINGS).			
	Drawing title		Drawing No.	
	a.) 1.0/1.6/2.0 MVA Transformer (Outdoor)		0000-000-POE-FB-002	
	b.) 0.5/0.63 MVA Transformer (Outdoor)		0000-000-POE-FB-001	
	c) Standard Terminal Numbers for Marshalling Box		0000-203-PVE-B-001	
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-II-E12 OUTDOOR TRANSFORMERS
Page 28 of 31				

1. TRANSFORMER SKID SHALL BE FIXED WITH ANCHOR FASTENERS BY VENDOR.
2. HV/LV CABLE BOX SUPPORT SHALL BE TAKEN FROM TRANSFORMER FOUNDATION OR FROM THE TOP OF SOAK PIT AND SHALL BE FIXED WITH ANCHOR FASTENERS BY VENDOR.

3. BUSDUCT SUPPORT SHALL BE TAKEN FROM THE WALL OF THE SWGR BUILDING AND SHALL BE FIXED WITH ANCHOR FASTENERS.

4. HEIGHT OF FIRE WALL SHALL BE 3.40M.

5. MAXIMUM WEIGHT OF TRANSFORMER IS 7 TONS.

6. FOUNDATION SHALL BE SUITABLE FOR POINT LOAD OF 2 JT.

7. LV BUSDUCT ENTRY TO TRANSFORMER SHALL BE FROM TOP.

7. LV BUSDUCT ENTRY TO TRANSFORMER SHALL BE FROM TOP.

6. (-----) SHOWS THE
BANK IN THE ISLAND VIEW

BANK IN THE PLAN VIEW.
 DERIVATIONS ARE NOT SHOWN IN VIEW D-D AND E-E

1. RADIATORS ARE NOT SHOWN IN VIEW B-B AND C-C.
CONSERVATOR CAN BE LOCATED ON EITHER SIDE OF THE TRANSFORMER

1. CONSERVATOR CAN BE LOCATED ON EITHER SIDE OF THE TRANSFORMER (REFER VIEW B-B).

1. TOP LV FLANGE OF TRANSFORMER SHALL BE FIXED BY CO-ORDINATE

MAXIMUM ALLOWABLE TOLERANCE

L. TRANSFORMER CAN BE MOVED

1. ALL DIMENSIONS ARE IN MM.

1. DIMENSIONS ARE NOT AS PER SCALE.

A. EL (+/-)0.00M CORRESPONDS TO FINISHED FLOOR U
FIRST. SHALL NOT BE USED FOR SLAB THICKNESS

3. FIRE WALL NOT REQUIRED FOR 1MVA TRANSFORMER.

TRANSFORMER RATING	HV SIDE XLPE CABLE SIZE (sq. mm)		
	11KV	6.6KV	3.3KV
1000 KVA	30x150	30x150	3-10x150
1600 KVA	30x150	30x150	—
2000 KVA	30x150	3-15x350	—

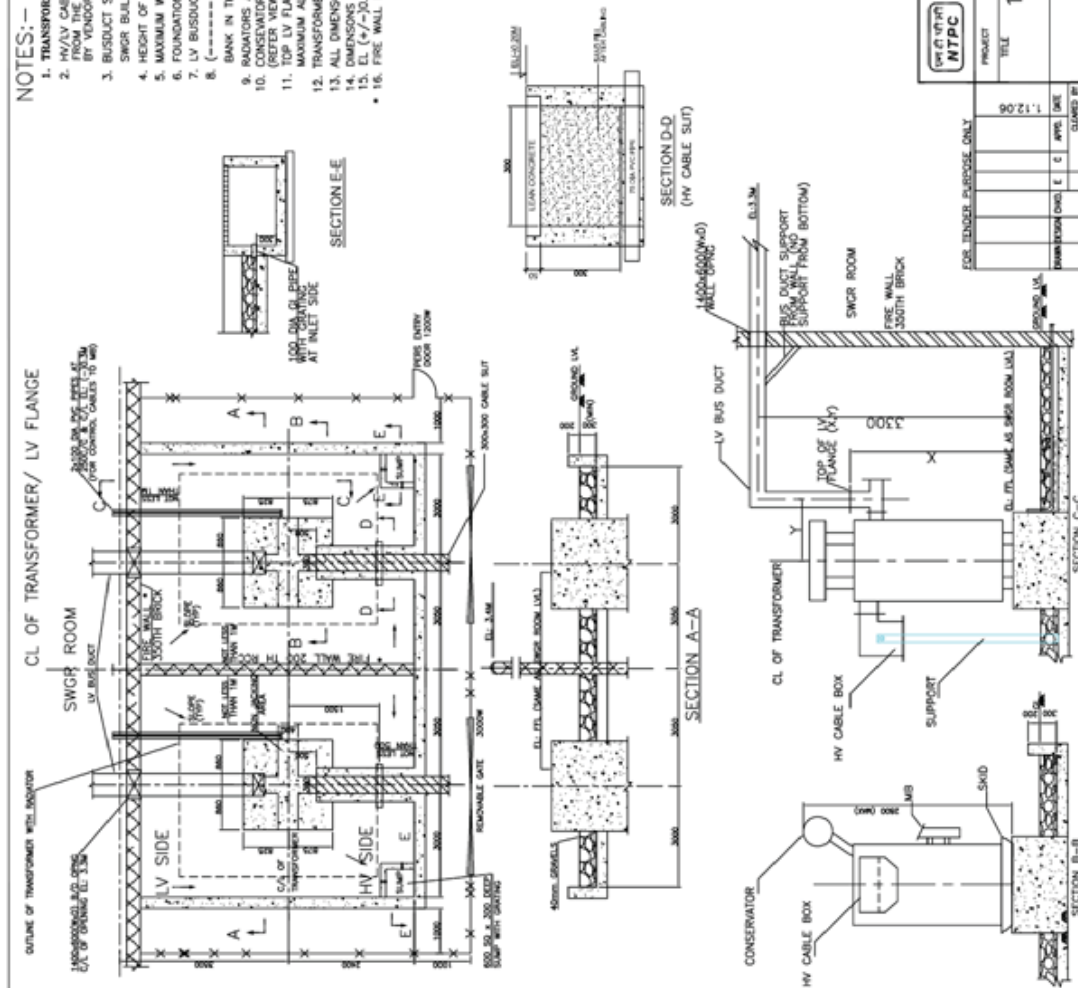
CABLE SIZE DETAIL	
1	1/2"
2	3/4"
3	1"
4	1 1/4"
5	1 1/2"
6	1 3/4"
7	2"
8	2 1/4"
9	2 1/2"
10	2 3/4"
11	3"
12	3 1/4"
13	3 1/2"
14	3 3/4"
15	4"
16	4 1/4"
17	4 1/2"
18	4 3/4"
19	5"
20	5 1/4"
21	5 1/2"
22	5 3/4"
23	6"
24	6 1/4"
25	6 1/2"
26	6 3/4"
27	7"
28	7 1/4"
29	7 1/2"
30	7 3/4"
31	8"
32	8 1/4"
33	8 1/2"
34	8 3/4"
35	9"
36	9 1/4"
37	9 1/2"
38	9 3/4"
39	10"
40	10 1/4"
41	10 1/2"
42	10 3/4"
43	11"
44	11 1/4"
45	11 1/2"
46	11 3/4"
47	12"
48	12 1/4"
49	12 1/2"
50	12 3/4"
51	13"
52	13 1/4"
53	13 1/2"
54	13 3/4"
55	14"
56	14 1/4"
57	14 1/2"
58	14 3/4"
59	15"
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61	15 1/2"
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65	16 1/2"
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67	17"
68	17 1/4"
69	17 1/2"
70	17 3/4"
71	18"
72	18 1/4"
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74	18 3/4"
75	19"
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77	19 1/2"
78	19 3/4"
79	20"
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83	21"
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85	21 1/2"
86	21 3/4"
87	22"
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89	22 1/2"
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97	24 1/2"
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126	31 3/4"
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129	32 1/2"
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141	35 1/2"
142	35 3/4"
143	36"
144	36 1/4"
145	36 1/2"
146	36 3/4"
147	37"
148	37 1/4"
149	37 1/2"
150	37 3/4"
151	38"
152	38 1/4"
153	38 1/2"
154	38 3/4"
155	39"
156	39 1/4"

RATING	DIMENSIONS mm		TOP OF FLANGE (to mm)		
	L	M	N	X	Y
1000 KVA	60	860	315	1500	730
1600 KVA	40	1000	380	1600	760
2000 KVA	40	1160	390	1750	810

	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	3300	3400	3500	3600	3700	3800	3900	4000	4100	4200	4300	4400	4500	4600	4700	4800	4900	5000	5100	5200	5300	5400	5500	5600	5700	5800	5900	6000	6100	6200	6300	6400	6500	6600	6700	6800	6900	7000	7100	7200	7300	7400	7500	7600	7700	7800	7900	8000	8100	8200	8300	8400	8500	8600	8700	8800	8900	9000	9100	9200	9300	9400	9500	9600	9700	9800	9900	10000
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CL OF TRANSFORMER/ IV FLANGE



NTPC

NTPC LIMITED

NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

CONCLUDING REMARKS

STANDARD DRAWING
1.0/1.6/2.0 MVA TRANSF (OUTDOOR)

- BUSDUCT, HV CABLE TERMINATION)

Page 100

0000-000-POF-FB-002
REV. 04/01

Terminal No.	Description	Remarks	
T-01	230V, Single Phase, 50Hz, AC Supply		
T-02			
T-03			
T-04			
T-05	MOG (Oil Level) Alarm		
T-06			
T-07	Buchholz Relay Alarm		
Dummy			
T-08			
T-09	Buchholz Relay Trip		
T-10			
T-11	PRV-1 Alarm	If applicable	
Dummy			
T-12	PRV-1 Trip		
T-13			
T-14	PRV-2 Alarm		
T-15			
Dummy	PRV-2 Trip		
T-16			
T-17	OTI Alarm		
T-18			
T-19	OTI Trip		
Dummy			
T-20			
T-21	WTI-1 Alarm		
T-22			
T-23	WTI -1 Trip		
Dummy			
T-24			
T-25	WTI-2 Alarm	If applicable	
T-26			
T-27	WTI -2 Trip		
Dummy			
T-28			
T-29	Neutral CT (for 64-REF Protection)	If applicable	
T-30			
T-31	Neutral CT (for 51N-Earth Fault Protection)		
T-32			
T-33	CT Shorting Terminal		
T-34	CT Shorting Terminal		
T-35	WTI 1-CT		
T-36			
T-37			
T-38	CT Shorting Terminal		
T-39	WTI 2-CT	If applicable	
T-40			
T-41	CT Shorting Terminal		
T-42	Spare Terminals for NTPC use		
T-43			
T-44			
T-45			
T-46			
T-47			
T-48			

Notes:

- 1 The Terminals from T-01 to T-48 shall be designated as indicated in the chart for all outdoor transformers (upto 16MVA)
- 2 The Terminals which are not used for a particular Transformer shall be left as spare. e.g. in case there is only one WTI alarm & trip, then terminals T-25 to T-28 & T-38 to T-40 shall be left as spare terminals.

Title: Standard Terminal Numbers for Marshalling Box of all Transformers

Drawing No.: 0000-203-PVE-B-001

SUB-SECTION-II-E13

ELEVATOR ELECTRICAL

**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		
	b. Contractor shall provide emergency indicator to indicate the location of elevator in case of elevator being stuck up between the floors through automatic flashers (both audio & visual). c. Contractor shall provide electronic door detector (Infra red curtain type). d. Digital hall position indicator at all floors, tell lights at all floors shall also be provided by the Contractor. e. For facilitating the movement of visually & hearing impaired persons, hall lantern and car arrival chimes shall be provided f. All fixtures shall be in stainless steel face plates. g. Push buttons shall be fixed in the car for holding the doors open for any length of the time required. h. All other safety/protection/operation interlocks as required by IS:14665 (latest edition).			
4.00.00	POWER SUPPLY Each elevator shall be provided with a separate three phase, three wire 415V feeder of adequate rating			
5.00.00	Controls: The controls shall be Variable Voltage and Variable frequency type and shall provide smooth and constant acceleration and retardation under all conditions of operation . Suitable control panel shall be provided in the machine room.			
6.00.00	Cables and wiring: All the cables except trailing cables shall be as per IS:1554-1 or IS-7098-I. the PVC outer sheath of these cables shall be flame retardant, low smoke (FRLS) type with the following FRLS properties. a) Oxygen index of min. 29 (as per IS:10810 Part-58) b) Acid gas emission of max. 20% (as per IEC-754-I). c) Smoke density rating shall not be more than 60% (as per ASTM D-2843). The circular trailing cables shall be either in accordance with IS 4289 Part-I (Elastomer insulated) or IS-4289 Part-II (PVC insulated). The flat type trailing cables if offered shall be in accordance with IEC-60227-6. All wiring / cabling between the equipments in the lift machine room and that between the machine room and equipments in the lift well and at the landings shall be wired in HDP conduits/ galvanized steel conduits to be supplied by the contractor. Alternatively armored cables may be used.			
7.00.00	Earthing: The elevator structures and all Electrical equipment, including metal conduits shall be effectively earthed with the earth conductors provided in the machine room as per IS: 3043.			
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-II-E13 Elevator Electricals	PAGE 2 OF 2

SUB-SECTION-II-E14

**FIRE PROOF CABLE PENETRATION SEALING
SYSTEM**

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		
	FIRE PROOF CABLE PENETRATION SEALING SYSTEM 1.00.00 CODES AND STANDARDS 1.01.00 The fire proof cable penetration (FPCP) sealing system shall conform to the requirement of latest edition including amendments of BS:476 Part-20 Fire tests on Building materials and structures. 1.02.00 Fire penetration seal complying with any other international standards will also be considered if it ensures performance equivalent or superior to standard listed above. 1.03.00 The Bidder shall clearly indicate the standards adopted and furnish a copy of the English version of the latest editions of standards alongwith the bid, and shall clearly bring out the salient features for comparison. 2.00.00 SYSTEM DESCRIPTION 2.01.00 The fire proof cable penetration sealing system shall be of the following types; i) Type - A Type A fire sealing system is either Silicone foam or equivalent foam system or using individual blocks for each cable along with suitable frame work rated for one hour. Type A is to be implemented at floor openings below C&I panels, control panels/Boards etc. in CER & CCR. ii) Type-B Type B fire sealing system is any proven fire sealing system rated for one hour. This will comprise of rest of wall and floor crossings of cables/cable trays, opening below HT/LT Switchgears/board other than those covered under Type A. 2.02.00 The penetration system, shall be installed immediately after the completion of cable termination in a particular switchboard/control panel/area after clearance from the Project Manager. 3.00.00 GENERAL INFORMATION 3.01.00 The cables shall generally be laid in cable trays/racks, conduits, ducts. The fire proof cable penetration system shall be designed in such a way that the existing supporting structure/cable is not disturbed. 3.02.00 The penetration system shall be suitable for site condition at 50⁰C ambient temperature and relative humidity of 100%.			
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-II-E14 FIRE PROOF CABLE PENETRATION SEALING SYSTEM	Page 1 of 10	

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.03.00	The penetration system of each wall/floor crossing shall be adequately designed/sized such that 20% addition of cables is possible at any later date without disturbance/wastage of material in the penetration system.			
3.04.00	Contractor shall plan the schedule of supply of the materials in consultation with Project Manager and use the material within stipulated shelf life of material. The area given in BOQ is for guidance to the vendor. After award of work, drawings for each penetration seal shall be prepared by the contractor after verifying the actual installation of cables at site and approval shall be taken from the Project Manager's representative before proceeding with the actual work. The requirement of fire sealing material shall be quantified accordingly. Fire sealing material to be supplied shall be based on the net area to be sealed, wastage, thickness, density and other parameters as per the type test report approved under this contract.			
4.00.00	TECHNICAL REQUIREMENTS			
4.01.00	The fire proof cable penetration system shall fully comply with the requirements of BS:476 Part-20 and also to the requirements specified in this specification.			
4.02.00	The penetration system shall prevent spreading of fire in cable beyond the seal system in case of fire and shall have minimum 1 hour fire resistance rating.			
4.03.00	The penetration system shall be physically, chemically, thermally stable and shall be mechanically secure to the masonry/concrete/structural members. The system shall be mechanically robust and capable of giving satisfactory performance under vibrations encountered in power stations.			
4.04.00	The penetration system shall be capable of withstanding mechanical loads, foot traffic drop loads, vibrations, wind pressure, etc.			
4.05.00	The penetration system shall be completely gas and smoke tight.			
4.06.00	The penetration system shall retain integrity and perform satisfactorily even after remaining in water for long period.			
4.07.00	The materials used in FPCP sealing system shall be non-toxic and harmless to the working personnel.			
4.08.00	The penetration materials shall have no reaction with cable sheath/galvanising/painting of structural steel.			
4.09.00	The penetration materials shall have anti-rodent and anti-termite properties.			
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-II-E14 FIRE PROOF CABLE PENETRATION SEALING SYSTEM	Page 2 of 10

CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.10.00	The penetration materials shall have no shrinkage or cracking after the setting for the complete life of the power Plant.	
4.11.00	Under normal load, short circuit and fire conditions, cables may be subjected to movement and vibration. The FPCP sealing system shall be designed to withstand and perform satisfactorily under these conditions.	
4.12.00	The penetration system shall not affect the current carrying capacity of cables passing through it.	
4.13.00	Asbestos shall not be used in the construction of fire penetration seal system.	
4.14.00	The penetration system shall have life expectancy of 40 years.	
4.15.00	The penetration system shall not emit any corrosive or toxic fumes or smoke on the unexposed face of the barrier.	
4.16.00	Any wastage of the compound during the process of mixing for preparing the FPCP sealing compound shall be to Contractor's account.	
4.17.00	For foam type of systems, only the foam shall form the penetration seal of specified rating, having the damming board removed after curing of the foam.	
5.00.00	PACKING AND STORAGE	
5.01.00	All materials and components of penetration system shall be supplied in packing to avoid contamination of materials due to dust/moisture and temperature during transit and storage. All packing shall be of durable quality and the date of expiry and the date of manufacture shall be printed on it.	
6.00.00	INSTALLATION	
6.01.00	The contractor shall take adequate care to ensure that cables are not damaged in any manner during penetration system installation.	
6.02.00	Wherever the floor/wall opening provided in the vicinity of penetration seals larger or smaller than that required for the cable fire penetration, these opening size can be reduced or increased in an approved manner by the contractor using the same materials as provided around the opening and of the same thickness. Generally the walls in the power station comprises of brickwork and the floors are made of RCC/steel work. The Contractor shall be paid for this work at the unit rates for the respective brickwork/ R.C.C.	
6.03.00	The work to be carried out under this specification shall be done under the supervision of Project Manager's representative.	
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-II-E14 FIRE PROOF CABLE PENETRATION SEALING SYSTEM Page 3 of 10

CLAUSE NO.	TECHNICAL REQUIREMENTS	
6.04.00	All work shall be carried out in accordance with the agreed “field quality plan” and approved drawings. The “field quality plan” shall additionally specify the fire sealing material thickness, minimum cured density and other related parameters achieved in the approved type tests for the contract. The work shall be done to the satisfaction of the Project Manager and the same shall be subject to Project Manager’s approval for acceptance.	
6.05.00	The installation shall be carried out in a neat workmen like manner by the skilled, experienced and competent workmen.	
6.06.00	Installation work at site shall be properly coordinated with other services.	
6.07.00	All materials being supplied or consumed during installation by the Contractor in the process of installation shall be of the best quality and according to relevant standards. All materials shall be inspected and approved by the Project Manager before the same is used for installation work. Also regarding inspection of work, the engineer shall have the right to inspect at any stage during installation, testing and commissioning.	
6.08.00	The drilling and welding of building-steel or fixing supports etc. shall be carried out by contractor after taking prior approval of Project Manager.	
6.09.00	Any work like chipping, breaking of existing structure like wall, floors, fabrications, any civil work etc. shall be done after taking prior approval of the Project Manager.	
6.10.00	The following jobs are also in the scope of contractor’s work and shall be carried out at no extra cost to the Employer: a) Reasonable amount of drilling, cutting and welding surface preparation to fix the fire stops. b) Supply of necessary cement, gravel, sand etc. required for grouting necessary supports. c) All supporting arrangement.	
7.00.00	TYPE TESTS, ROUTINE & ACCEPTANCE TESTS	
7.01.00	All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to the date of techno-commercial 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.	
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-II-E14 FIRE PROOF CABLE PENETRATION SEALING SYSTEM		Page 4 of 10

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.02.00	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of techno-commercial bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.			
7.03.00	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.			
7.04.00	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.			
7.05.00	Following Type test reports as per the setup and procedures given in subsequent clauses for the Fire proof cable penetration sealing system shall be submitted: a) The accelerated ageing test b) Water absorption test c) Fire rating test d) Hose stream test e) Vibration test followed by fire rating test			
7.05.01	Tests a, b, c and d should have been carried out on same test sample subsequently one after the other without any touching up/repair/modifications in the same sequence and in accordance with the clause 9.00.00. The test sample shall be assembled as per clause 8.00.00.			
7.05.02	Test indicated in clause 7.05.00 (e) above should have been carried out on a separate sample and as per the procedure indicated under clause 9.05.00.			
7.05.03	Physical, chemical and mechanical properties of various components/ingredients used should have been also be tested as a part of type tests.			
7.05.04	Test reports shall contain the following information: 1. Type of penetration material tested			
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-II-E14 FIRE PROOF CABLE PENETRATION SEALING SYSTEM	Page 5 of 10	

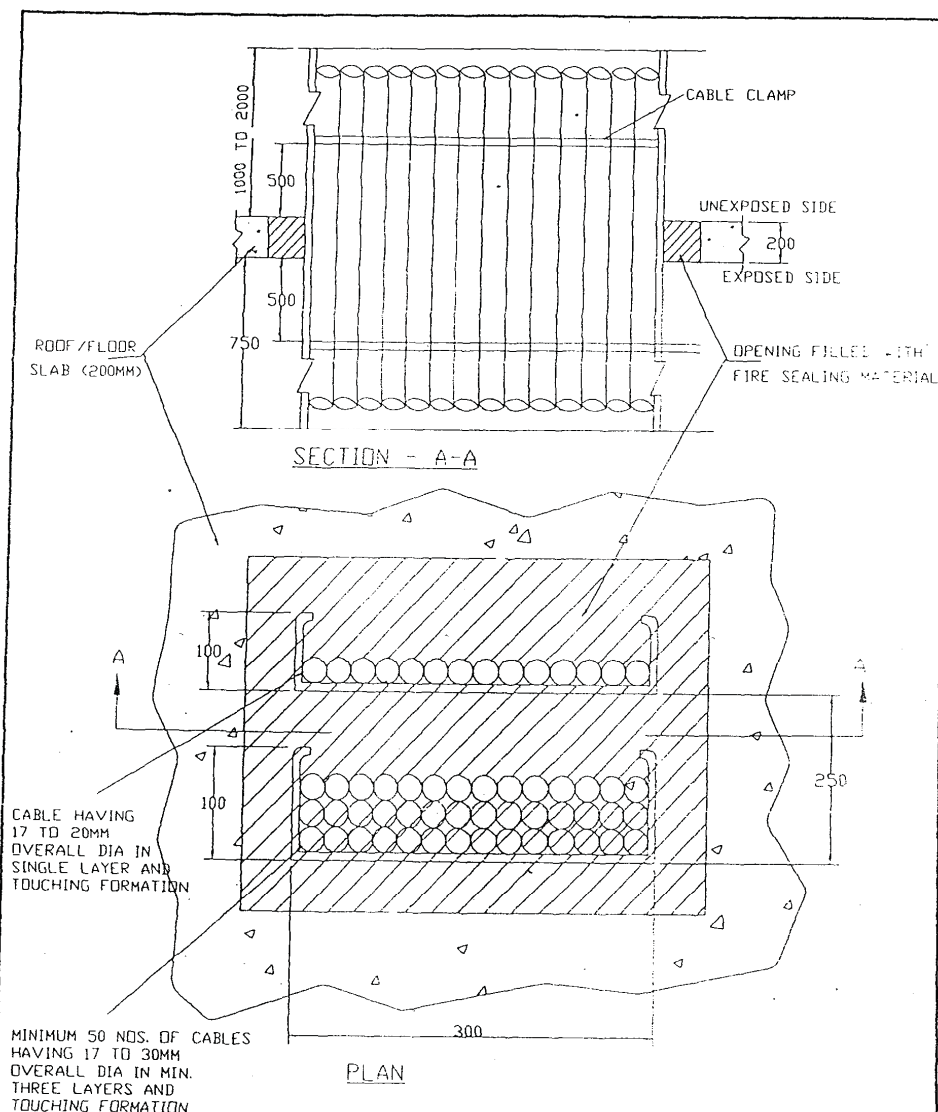
CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	2. Details of various components/ingredients used alongwith their catalogue. 3. Physical, chemical and mechanical properties of various components/ingredients used. 4. Description of the various test assemblies tested. 5. Details of method of conditioning. 6. The observations as called for in BS:476 Part-20 and technical specification.	
7.06.00	ROUTINE & ACCEPTANCE TESTS Routine and acceptance tests to be carried out on Type-A and Type-B cable fire sealing system shall be mutually agreed based on the type of fire sealing material offered before placement of award.	
8.00.00	TEST SPECIMEN ASSEMBLY	
8.01.00	The test specimen shall be assembled as per enclosed drawing and shall resemble typical floor crossing cable penetration system.	
8.02.00	The test specimen shall be designed to seal an opening of adequate size in a concrete slab of 200 mm thickness. Two lengths of 300/600 mm wide ladder type cable tray shall be assembled with required layer of XLPE/PVC insulated, PVC sheathed unarmoured cables in touching formation. Type and number of cables in the cable tray shall be as per enclosed drawing. Cables shall be adequately clamped with tray at both the sides of the penetration as shown in the drawings. However, for penetration system with blocks which require staggered arrangement, cables can be clamped at an adequate distance from the penetration and the tray need not pass through the penetration seal.	
8.03.00	The opening in the test specimen then shall be sealed with fire proof cable penetration sealing materials.	
9.00.00	TEST PROCEDURES	
9.01.00	ACCELERATED AGEING TEST The test specimen assembled as per clause 8.01.00 with damming board removed shall be subjected to accelerated ageing test by storing in air furnace where the temperature of the inside air shall be maintained at 85 degree centigrade for 168 hours. The temperature controlled furnace should have 7 air changes per hour approx.	
9.02.00	WATER ABSORPTION 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-II-E14 FIRE PROOF CABLE PENETRATION SEALING SYSTEM Page 6 of 10

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
9.02.01	The test specimen shall be immersed in fresh clean water at a temperature of 20 deg. C $\pm$ 2 deg C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hour soak period the specimen shall be removed from water and mopped up with a damp cloth.			
9.03.00	FIRE RATING TEST			
9.03.01	The test specimen after withstanding water absorption test shall be subjected to fire rating test as per BS: 476 part-20.			
9.03.02	Oil/Gas fired furnace shall be used for heating. The furnace shall have achieved standard time/temperature characteristics for fire tests as per BS:476 part-20.			
9.03.03	The pressure inside the furnace at the time of test shall be within 1.5 $\pm$ 0.5 mm water gauge.			
9.03.04	Cables in the test specimen shall be anchored on the hot side to a structure independent of the barrier and its penetrations. This is to ensure that any differential movement between the penetration and the cable that could occur during a fire, is produced in the type tests and the reliability of the integrity of the penetration is checked.			
9.03.05	Cables shall be protruding between 1 to 2 metre, from the penetration face on the unexposed side and protruding into the furnace as far as it is practicable with a minimum length 750 mm. The ends of the cables shall be capped on the unexposed face to prevent gases and fumes to escape from the furnace during the fire.			
9.03.06	The test specimen shall be subjected to fire test with surface exposed to controlled fire in the furnace confirming to time/temperature characteristics specified in BS:476(20).			
9.03.07	During the test the temperature of both the faces of the fire stop i.e. one which is exposed to fire and other unexposed shall be measured by calibrated thermo couples after regular interval of 5 minutes.			
9.03.08	Atleast 3 thermo couples shall be provided for temperature measurement of each face. The results at the end of the test shall be interpreted for failure criteria as under. - The system is deemed to have failed to maintain stability if there is a total collapse of the fire proof seal. - In case cracks are seen on the face of the fire stop or cracks through which the flame/ hot gas can pass the systems deemed to have failed to maintain integrity.			
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-II-E14 FIRE PROOF CABLE PENETRATION SEALING SYSTEM	Page 7 of 10

CLAUSE NO.	TECHNICAL REQUIREMENTS	
9.03.09	The development of crack is characterised by appearance of black soot on cotton wool held near the penetration on the unexposed surface at a distance of about 100mm. 3. Failure shall be deemed to have occurred when the mean temperature of the unexposed surface of the specimen assembly increases by more than 140⁰C above the initial temperature or if the temperature of the unexposed surface is increased at any point by more than 180⁰C above the initial temperature. During the test the specimen shall meet all the three criteria simultaneously. Temperature measurement on the unexposed side of penetration seal shall be measured by thermocouples at a distance of 25 mm from unexposed side of fire stop.	
9.04.00	HOSE STREAM TEST	
9.04.01	A hose stream test shall be conducted on the test specimen immediately following a fire resistance test on that assembly. The specimen must first be removed from the furnace since the hose stream is to be applied to the exposed face. This must be done quickly since it is the intention of the test that the stream be applied to the specimen whilst it is hot.	
9.04.02	The hose stream shall be long range narrow angle, (20 ⁰ - 90 ⁰ set at 30 ⁰ included angle). High velocity water spray provided from a 28 mm hose discharging through an appropriate nozzle. The water pressure shall be 5 bar calculated at the base of the nozzle and the minimum flow rate shall be 4.7 litres/second. The stream shall be supplied perpendicularly to the exposed face of the test specimen with nozzle 3 m away from the exposed face.	
9.04.03	Application shall be for minimum of two and a half minutes per 9 sq.m. of the test specimen including the barrier.	
9.05.00	VIBRATION TEST	
9.05.01	The test assembly is to comprise a single ladder rack penetration in 1 m x 1m high normal section of fire barrier which is securely supported. The penetration seal shall be formed in the middle of the barrier around 1 m length of 600 mm ladder rack. The tray shall be fully loaded with cables in touching formation. The penetration assembly shall be formed symmetrically through the fire barrier as in service. The penetration sealant material shall then be allowed to cure for atleast as long as the	
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-II-E14 FIRE PROOF CABLE PENETRATION SEALING SYSTEM Page 8 of 10

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
9.05.02	time required for conditioning to constant mass. A vibration test shall then be conducted on the sample as set out below. The vibration shall be of 100 Hz frequency and of 0.5 mm amplitude (1.0 mm peak to peak) and this shall be applied to one rail of the ladder rack or the centre of a cross member secured to the two rails at 250 mm from the centre line of the penetration. This vibration shall be applied to the sample for the minimum period of 3 hrs. Immediately following this vibration test the barrier/ penetration assembly shall be successfully subjected to a fire test in accordance with clause no. 9.03.00.			
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-II-E14 FIRE PROOF CABLE PENETRATION SEALING SYSTEM	Page 9 of 10	

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**NOTES:**

1. IN CASE OF BLOCK TYPE SYSTEM ARRANGEMENT SHALL BE WITH FRAME & BLOCKS HOWEVER NUMBER OF CABLES SHALL REMAIN SAME.
2. ALL DIMENSIONS ARE IN MM ONLY.
3. CABLES TO BE USED SHALL BE OF DIFFERENT DIA. ALL THE CABLES SHALL NOT BE OF SAME DIA.

RB FOR TENDER PURPOSE		RE	BY	AP	-	-	-	12	5	20
RA	FOR TENDER PURPOSE	NO	BY	AP	-	-	-	12	5	20
REV.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	DATE
NO.					Cleared By					
एनटीपीसी NTPC NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION										
PROJECT STANDARD										
TITLE FIRE PROOF CABLE PENETRATION SYSTEM TEST SETUP										
SIZE	SCALE	DRG. NO.						REV. NO.		
A4	NTS	0000-211-PDE-A-051						RB		

211-051.dwg

38

SUB-SECTION-II-E15

LIGHTING

**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			
1.00.00	GENERAL			
1.01.00	This specification covers the general description of design, manufacture and construction features, testing, supply, installation and commissioning of the Lighting system equipment.			
2.00.00	CODES AND STANDARDS			
2.01.00	All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions as on date of bid opening. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards & codes.			
2.02.00	Lighting Fixtures and Accessories			
	IS:1913	General and safety requirements for luminaires.		
	IS:2148	Flame proof enclosures of electrical apparatus.		
	IS:418	Tungsten filament general service electric lamps.		
	IS:1258	Bayonet lamp holders.		
	IS:1534	Ballast for fluorescent lamps.		
	IS:1569	Capacitors for use in tubular fluorescent, high pressure mercury vapour and low pressure sodium vapour discharge lamp circuit.		
	IS:1777	Industrial luminaire with metal reflectors.		
	IS:2215	Starters for fluorescent lamps.		
	IS:2418	Tubular fluorescent lamps for general lighting services.		
	IS:3323	Bi-pin lamp holders for tubular fluorescent lamps.		
	IS:3324	Holders for starters for tubular fluorescent lamps.		
	IS:4013	Dust-tight electric lighting fittings.		
	IS:8224	Electric Lighting fittings for Division 2 areas.		
	IS:10276	Edison screw lamp holders.		
	IS:10322	Luminaires.		
	IS:13021	AC Supplied Electronic Ballasts for tubular fluorescent lamps.		
2.03.00	Lighting Panels, Switch-boxes, Receptacles and Junction Boxes			
	IS:2147	Degree of protection provided by enclosures for low-voltage switchgear and control gear.		
	IS:1293	Plugs & socket outlets of rated voltage upto and Including 250volts & rated current upto and including 16 Amps.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUBSECTION-II-E15 STATION LIGHTING	Page 1 of 16

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.04.00	IS:2551	Danger notice plates.		
	IS:13947	Low voltage switchgear and controlgear		
	IS:3854	Switches for domestic and similar purposes.		
	IS:6875	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto and including 1000 V AC and 1200 V DC.		
	IS:13703	Low voltage fuses for voltages not exceeding 1000V AC or 1500 V DC.		
	Conduits, Pipes and Accessories			
2.05.00	IS:2667	Fittings for rigid steel conduit for electrical wiring.		
	IS:3837	Accessories for rigid steel conduits for electrical wiring.		
	IS:9537	Conduits for electrical installations.		
	Lighting Wires/Cables			
2.06.00	IS:694	PVC insulated cables for working voltages upto and including 1100 V		
	IS:3961	Recommended current ratings for cables.(PVC Insulated and PVC sheathed heavy duty cables and light duty cables).		
	IS:8130	Conductors for insulated electric cables and flexible cords.		
	IS:10810	Methods of tests for cables.		
		LED Luminaries		
	16101:2012	General Lighting. LEDs and LED modules Terms and definitions		
	16102(Part 1):2012	Self Ballasted LED Lamps for General Lighting Services. Part-1 Safety Requirements.		
	16102(Part 2):2012	Self Ballasted LED Lamps for General lighting Services. Part-2 Performance Requirements.		
	16103(Part I):2012	LED modules for General lighting Safety Requirements.		
	15885(Part 2/Sec. 13) :2012	Lamp control gear Part 2 particular Requirements Section 13 d.c. or a.c. Supplied Electronic control gear for LED modules		
	16104:2012	d.c. or a.c. Supplied Electronic control gear for LED modules - Performance Requirements.		
	16105:2012	Method of Measurement of Lumen maintenance of Solid-state Light (LED) Sources.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUBSECTION-II-E15 STATION LIGHTING
Page 2 of 16				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.07.00	16106:2012	Method of Electrical and photometric Measurements of Solid State Lighting (LED) Products		
	16107:2012	Luminaires Performance		
	16108:2012	Photobiological safety of Lamps and Lamp Systems		
	IS 513	Cold rolled low carbon steel sheets and strips		
	IS 12063	Classification of degree of protection provided by enclosures.		
	IS 14700	Electro magnetic compatibility (EMC) – Limits (Part 3/Sec. 2) for Harmonic current emission – THD < 15% (equipment, input current < 16 Amps. per phase.		
	IS 9000 (Part 6)	Environment testing: Test Z – AD: composite temperature/humidity cyclic test.		
	IS 15885	Lamp control gear: particular requirements for (Part 2/Sec. 13) DC or AC supplied electronic control gear IS 16004 – 1 and 2) for LED modules.		
	IS 4905	Method for random sampling		
	Electrical Installation Practices & Miscellaneous			
	IS:1944	Code of practice for lighting of public thorough fare		
	IS:3646	Code of practice for interior illumination.		
	IS:5572	Classification of Hazardous areas (other than Mines) having flammable gases and Vapours for electrical installation		
	S:6665	Code of practice for industrial lighting.		
	.	National Electrical Code		
	-	Indian Electricity Rules.		
	IS:5	Indian Electricity Act Colour for ready mixed paints & enamels.		
	IS:280	Mild steel wires for general engineering purposes.		
	IS:374	Electric ceiling type fans & regulators.		
	IS:732	Code of practice for electrical wiring installations.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUBSECTION-II-E15 STATION LIGHTING	Page 3 of 16

CLAUSE NO.	 TECHNICAL REQUIREMENTS			
	IS:1255 Code of practice for installation and maintenance of power cables Upto and including 33KV rating. IS:2062 Steel for general structural purposes IS:2629 Recommended practice for hot-dip galvanizing of iron and steel. IS:2633 Methods for testing uniformity of coating of zinc coated articles. IS:2713 Tubular steel poles for overhead power lines. IS:3043 Code of practice for earthing IS:5216 Guide for safety procedures and practices in electrical work. IS:5571 Guide for selection of electrical equipments for hazardous areas. BS:6121 Mechanical cable glands			
3.00.00	LIGHTING SYSTEM DESCRIPTION			
3.01.00	The illumination of various indoor and outdoor areas in the main plant & offsite area shall be provided as described here. The lighting system of various areas shall comprise of the following systems as identified in Annexure-B: (a) Normal AC Lighting System (b) Emergency AC Lighting System (c) DC Lighting System			
3.02.01	Normal AC Lighting System Normal AC lighting system 415V, 3Phase, 4wire, will be fed from lighting panels (LPs) which in turn will be fed from the lighting distribution boards (LDBs)/Switch board MCC.			
3.02.02	Emergency AC Lighting System This system shall be provided for certain important areas in the main plant. The lighting fixtures connected to this system shall be normally "ON" along with the normal AC system. These will be fed from emergency lighting panels (ELPs) which in turn will be fed 3-phase, 4-wire supply from the emergency lighting distribution boards (ELDB'S). These lights will go off for a few seconds in case of AC supply failure at Emergency Switchgear, but shall be automatically restored when Emergency Switchgear is energised by Diesel generator set.			
3.03.00	DC Lighting System			
3.03.01	At strategic locations in the main plant, a few lighting fixtures fed from 220V, DC supply, shall be provided to enable safe movement of operating personnel and access to important control points during an emergency, when both the normal AC and Emergency Lighting system fail. These lighting fixtures will be fed from 220V DC LDBs which in turn will be fed from DC lighting panels.			
3.03.02	The supply to the DC lighting panels shall be automatically switched ON in case of loss of AC supply at station service switchgear as well as Emergency switch-gear. The DC			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUBSECTION-II-E15 STATION LIGHTING	Page 4 of 16

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
3.03.03 3.03.04	supply will be automatically switched OFF after about 3 minutes following the restoration of supply to normal AC or emergency AC lighting system. Emergency DC lighting is to be provided, through self-contained DC emergency fixtures with four hours back-up duration, at strategic locations, in auxiliary/offsite buildings wherever DC supply system is not available. The fixtures shall be switched 'ON' automatically in case of failure of AC supply. For Coal Handling plant./FGD Plant Area 100W, 220V DC Lighting fixture shall be provided in underground portion of conveyor, each switchgear room, control room, office room, pump house, each drive floor of TPs, staircases of various TPs and buildings and each local control area. DC lighting fixtures shall be fed from 220V DC LDB which in turn will be fed from CHP DC system. The supply to the DC lighting panels shall be automatically switched ON in case of loss of normal AC supply.		
4.00.00	DESIGN PHILOSOPHY - A comprehensive illumination system shall be provided in the entire areas. - All outdoor lighting system shall be automatically controlled by synchronous timer. Provision to bypass the timer shall be provided in the panel. - The system shall include distribution boards, normal/ emergency lighting panels, lighting fixtures, junction boxes, receptacles, switch boards, lighting pole/masts, conduits, cables and wires, etc. The system shall cover all interior and exterior lighting such as area lighting etc. The constructional features of lighting distribution boards shall be similar to AC/DC distribution boards described in chapter of LT Switchgear. Outgoing circuits in LPs shall be provided with MCBs of adequate ratings. - The illumination system shall be designed on the basis of best engineering practice and shall ensure uniform, reliable, aesthetically pleasing and glare free illumination. The lighting fixtures shall be designed for minimum glare. The design shall prevent glare/luminous patch seen on VDU/ Large video screens, when viewed from an angle. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection. The diffusers/ louvers used in fixtures shall be made of impact resistant polystyrene sheet and shall have no yellowing property over a prolonged period. The Lux levels to be adopted for various area are indicated at Annexure - A. (placed at the end of this Chapter). - While finalizing the detailed layout of lighting fixtures, the position/location and layout of equipments should be taken into account to have adequate illumination at desired locations. LED Luminaires: LED Luminaires shall be used for the lighting of all the indoor & outdoor areas in bidder's scope. However for DC lighting, hazardous areas lighting etc. conventional type luminaires shall be used. In false ceiling area LED luminaires shall be recessed mounting type & in non-false ceiling area the LED luminaires shall be surface mounting type. The individual lamp wattage for LED shall be upto 3 watt. Fractional wattage LEDs are also acceptable. The LED chip efficacy shall be min 120 Lm/W. The		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUBSECTION-II-E15 STATION LIGHTING	Page 5 of 16

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																
	luminaire efficacy shall be not less than 80 Lm/W. Suitable heat sink shall be designed & provided in the luminaire. The LED used in the luminaires shall have colour rendering index (CRI) of Min 80. Colour designation of LED shall be “cool day light” (min 5700K) type for indoor areas. However for outdoor areas, the colour temperature of LED shall be min. 4000K, including rough & dust prone areas. LED shall conform to the LM 80 requirements. The max. junction temperature of LED shall be 85 deg C. Further the lumen maintenance at this temperature shall be min 90%. The THD of LED Luminaires shall be less than 10%. Further the EMC shall be as per IS 14700. The power factor of the luminaire shall not be less than 0.9. The marking on luminaire & safety requirements of luminaire shall be as per IS standards. Suitable heat sink with proper thermal management shall be designed & provided in the luminaire. The connecting wires used inside the system, shall be low smoke halogen free, fire retardant type and fuse protection shall be provided in input side specifically for LED luminaires. Care shall be taken in the design that there is no water stagnation anywhere in the housing of luminaire. The entire housing shall be dust and water proof protection as per IS 12063.																			
7.	Driver Circuit LED modules and drivers shall be compatible to each other. The LED module driver's ratings and makes shall be as recommended by corresponding LED chip manufacturer. LED Drivers shall have following control & protections:- • Suitable precision current control of LED. • Open Circuit Protection • Short Circuit Protection • Over Temperature Protection • Overload Protection																			
8.	Apart from maintenance factor as given below, Temperature correction factor shall be considered in the lighting design for fixtures located in non air conditioned area. <table><tr><td>(a.)</td><td>Office area (air conditioned)</td><td>:</td><td>0.8</td></tr><tr><td>(b.)</td><td>Office area (non air conditioned) and other indoor area</td><td>:</td><td>0.7</td></tr><tr><td>(c.)</td><td>Dust prone indoor and outdoor area</td><td>:</td><td>0.6</td></tr><tr><td>(d.)</td><td>Coal Handling area, Ash Handling Conveyor /Transfer Points etc.</td><td>:</td><td>0.5</td></tr></table>				(a.)	Office area (air conditioned)	:	0.8	(b.)	Office area (non air conditioned) and other indoor area	:	0.7	(c.)	Dust prone indoor and outdoor area	:	0.6	(d.)	Coal Handling area, Ash Handling Conveyor /Transfer Points etc.	:	0.5
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(d.)	Coal Handling area, Ash Handling Conveyor /Transfer Points etc.	:	0.5																	
9.	(i) All outdoor fixtures shall be weather proof and of min. IP65 degree of protection. (ii) For Indoor type of fixtures:- (a) Surface/Pendent mounting: - IP 54 class of protection. (b) Recess Mounting (False ceiling):- IP 20 class of protection																			
10.	(a) Lighting panels shall be constructed out of 2 mm thick CRCA sheet steel. The door shall be hinged and the panel shall be gasketted to achieve specified degree of protection. Lighting panels shall be powder coated with color shade RAL9002. Lighting panels shall have min. IP55 degree of protection.																			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUBSECTION-II-E15 STATION LIGHTING																
Page 6 of 16																				

CLAUSE NO.	 TECHNICAL REQUIREMENTS		
	(b) All MCBs/Isolators/Switches/Contactors etc. shall be mounted inside the panel and a fibre glass sheet shall be provided inside the main door such that the operating knobs of MCBs etc., shall project out of it for safe operation against accidental contact. (c) Terminal blocks shall be 1100 V grade, clip-on stud type, made up of polyimide 6.6 or better suitable for terminating multicore 35 or 70 Sq. mm. stranded aluminium conductor incoming cable and 10 Sq. mm. stranded aluminium conductor for each outgoing circuits voltage. All terminals shall be shrouded, numbered and provided with identification strip for the feeders. (d) MCB's shall be current limiting type with magnetic and thermal release suitable for manual closing and automatic tripping under fault condition. MCB's shall have short circuit interrupting capacity of 9 KA rms. MCB knob shall be marked with ON/OFF indication. A trip free release shall be provided to ensure tripping on fault even if the knob is held in ON position. MCB terminal shall be shrouded to avoid accidental contact. (e) Contactors of AC lighting panels shall be 3 no's, 32 A, 3 pole continuous duty MCB, load make-break type suitable for 415 V, 3 phase 4 wire system. HRC fuses with suitable mounting base of 125A shall be provided in the incomer of Contactors in the LP. (f) DC switches shall be rotary type, 2 pole, continuous duty, load break type, quick make quick break, suitable for 220 V DC, 2 wire system. Switch knob shall be provided with ON/OFF indication. (g) Programmable Digital Timer shall be Electronic Astronomical Almanac Time switch with battery back up of min. TEN years, 4 Digit LED display, 24 hours range, manual override facility, 10 Amp 3 relay output, with NO/NC Contacts suitable for operation on 240V single phase AC supply. (h) Each lighting panel (LP-3) shall be fed from a 415V/42V, 3 phase-4 wire, 3 KVA transformer. The transformer shall be located inside the lighting panel itself. Transformers shall be dry type, natural air cooled with class F insulation or better. Impedance of transformer shall be 5%. Transformers shall be tested as per IS:11171. Off-circuit tap changer with +/- 5% in steps of +/- 1.25% tapping shall be provided. One minute power frequency withstands voltage for lighting transformer shall be 2.5 KV.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUBSECTION-II-E15 STATION LIGHTING	Page 7 of 16

CLAUSE NO.	TECHNICAL REQUIREMENTS					
	(i) Lighting Panels shall be of following types:					
	TYPE	INCOMER FEEDER	OUTGOING FEEDERS	DETAIL OF CONTENTS		
	LP-1	3No. 415V, 32 A, TP MCB (31/2Cx70sq.mm cable)	18Nos.,20A, 240V MCB	415V, 63A(min.), AC2 duty contactor and Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP:55 degree of protection		
	LP-2	3No. 415V, 32 A, TP MCB (31/2Cx35sq.mm cable)	9 Nos.,20A, 240V MCB	415V, 63A(min.), AC2 duty contactor and Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP:55 degree of protection		
	LP-3	1 No., 4A fuse 3 KVA transformer,40A TPN MCB	24 Nos., 16A, 45V MCB	IP 55 degree of protection. Incomer shall be suitable for receiving 4Cx16 sq. mm cable and outgoing circuit shall be suitable for 2Cx16 sq. mm cable.		
	LP-D1	1No. 220V,32 A, DP Isolator (2Cx35sq.mm cable)	6Nos.,16A, 220V DP Switch & Fuse	220V,32A DC Fuse, etc. outdoor type IP:55 degree of protection.		
	11.	Wires of different phase shall normally run in separate conduit.				
	12.	Power supply shall be fed from 415 / 240 V normal AC supply, emergency AC supply and 220V DC supply through suitable number of conveniently located lighting distribution boards (LDB) and lighting panels (LP). AC lighting supply shall be isolated from main supply by 2x100% isolation transformers of max. rating of 100KVA for 10/15 nos. outgoing feeder with changeover switch facility.				
	LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUBSECTION-II-E15 STATION LIGHTING	Page 8 of 16

CLAUSE NO.	TECHNICAL REQUIREMENTS 																							
	The isolation transformer shall be fed from two different bus sections of MCC and fault level restricted to 3 KA at Lighting Panels. 13. Atleast one 6/16A, 240V AC universal socket outlet with switch shall be provided in offices, cabins, etc. Further 20A, 240V AC industrial receptacle with switch shall be provided strategically in all industrial areas. Suitable number of 63A, 3ph, 415V AC industrial receptacles shall be provided for entire plant for welding purposes, particularly near all major equipment and at an average distance of 50m. Atleast one 63A, 3ph, 415V AC receptacle shall be provided in each floor of off-site buildings/ structures. Receptacles boxes shall be fabricated out of 2 mm thick MS steel hot dip galvanized or of not less than 2.5 mm thick die-cast aluminium alloy or fabricated out of 2 mm thick CRCA sheet with electro static powder coating. IP-degree of protection shall be applicable to receptacles Type 'RA &'RC' only Receptacles shall be of following types : <table border="1"> <thead> <tr> <th>Type</th><th>Switch rating</th><th>Socket & plug rating</th><th>Type & make of plug & Socket</th><th>Terminal Block size</th></tr> </thead> <tbody> <tr> <td>RA</td><td>20 A, SP240V AC(Industrial)</td><td>20A, 3 pin240 V AC</td><td>NTPC appd. make</td><td>1-4 way, suitable for loop- in loop- out of 10 sq.mm. Al. Conductor</td></tr> <tr> <td>RB</td><td>16A, S.P240V AC</td><td>6A+16A6 Pin decorative Piano-key Type Switch</td><td>NTPC appd.make</td><td>1-4 way, suitable for loop- in loop- out of upto 10 sq.mm. Al. Conductor</td></tr> <tr> <td>RC</td><td>20 A, SP24 V AC(Industrial)</td><td>20A, 3 pin24 V AC</td><td>NTPC appd. make</td><td>1-4 way, suitable for loop- in loop- out of 2 core -16 sq.mm. Al. Cable.</td></tr> </tbody> </table> 14. In the hazardous areas like Hydrogen generation plant, fuel oil handling areas or any other gas/ liquid fuel storage/ handling areas in bidder's scope, lighting shall be flame proof. 15. The type of fixtures, LP, JB, and receptacle used in Hydrogen generation plant building shall be suitable for group II C as per IS: 2148 or class I, Division II as per NEC 70-428. 16. All flourescent lamps shall be have "Cool day light" colour designation. The mirror optics type flourescent fixtures shall have no irridescence effect. Fixtures with better efficiency and upgraded proven system may also be considered In candescent lamps may be used only with DC Lighting. 17. Aviation warning lights shall be provided as per the recommendations of ICAO and Director general of civil aviation, India. The arrangement of light should be marked such that the object is indicated from every angle in azimuth. The				Type	Switch rating	Socket & plug rating	Type & make of plug & Socket	Terminal Block size	RA	20 A, SP240V AC(Industrial)	20A, 3 pin240 V AC	NTPC appd. make	1-4 way, suitable for loop- in loop- out of 10 sq.mm. Al. Conductor	RB	16A, S.P240V AC	6A+16A6 Pin decorative Piano-key Type Switch	NTPC appd.make	1-4 way, suitable for loop- in loop- out of upto 10 sq.mm. Al. Conductor	RC	20 A, SP24 V AC(Industrial)	20A, 3 pin24 V AC	NTPC appd. make	1-4 way, suitable for loop- in loop- out of 2 core -16 sq.mm. Al. Cable.
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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(1A)-2	SUBSECTION-II-E15 STATION LIGHTING	Page 9 of 16																				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	aviation warning lighting system shall also conform to the latest Indian standard IS 4998. 18. Contractor shall demonstrate the average lux level achieved for different areas as per specification requirements, after completion of the lighting work, at site to the satisfaction of engineer-in-charge. 19. In the Offsite area / buildings DC lighting shall be provided by self-contained 90 minutes duration Emergency lighting fixtures. Each shall be provided with Ni-cd battery, battery Charger & 2x10 W fluorescent lamps			
4.01.00	Ballasts			
4.01.01	All fluorescent fixtures except for Class-I, Div-II fittings/ increased safety fittings (Div-II/Hazardous Area) shall be provided with electronic ballasts.			
4.02.00	All luminaires and their accessories and components shall be of type readily replaceable by available Indian makes.			
4.03.00	Fans & Regulator			
4.03.01	Ceiling Fans, to be provided in non air-conditioned office/control room area. Further tentatively one (1) no. ceiling fan shall be provided for 10 sq.m area, at suitable mounting height. The ceiling fans shall be suitable for operation on 240 V +/-10%, 50 Hz, AC supply comprising of class 'E' or better insulated copper wound single phase motor, 1200mm sweep, aerodynamically designed well balanced AL blades (3 Nos.), down rod, die cast aluminium housing, capacitor, suspension hook, canopies etc. finished in stove enameled white or with electro static powder coating. Power factor of fans shall not be less than 0.9. Fan regulators shall be stepped electronic type suitable for operation on 240V +/-10% AC supply.			
4.04.00	Junction Boxes, Conduits, Fitting & Accessories, Pull Out Boxes:			
	Junction box for indoor lighting shall be made of fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type.			
	Junction boxes for street lighting poles and lighting mast if applicable , shall be deep drawn or fabricated type made of min. 1.6 mm thick CRCA Sheet. The box shall be hot dip galvanized. The degree of protection shall be IP55.			
	All switches and receptacles upto 16A shall be modular type. These shall be provided with pre-galvanized/galvanized modular switchbox & plate.			
	Conduits, Pipes and Accessories Galvanised heavy duty steel conduits for normal area and galvanised heavy duty steel conduits with an additional epoxy coating for corrosive area shall be offered. Alternatively glass reinforced epoxy conduits with comparable compressive and impact strength with that of heavy duty steel conduits may be offered.			
	Rigid steel conduits shall be heavy duty type,hot dip galvanised conforming to IS : 9537 Part-I & II shall be suitable for heavy mechanical stresses, threaded on both sides and threaded length shall be protected by zinc rich paint. Conduits shall be smooth from inside and outside.			
	Flexible conduit shall be water proof and rust proof made of heat resistant TERNE coated steel.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUBSECTION-II-E15 STATION LIGHTING
Page 10 of 16				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Pull out boxes shall be provided at suitable interval in a conduit run .Boxes shall be suitable for mounting on Walls, Columns, Structures, etc.. Pull-out boxes shall have cover with screw and shall be provided with good quality gasket lining. Pull out boxes used outdoor shall be weather proof type suitable for IP: 55 degree of protection and those used indoor shall be suitable for IP: 52 degree of protection. Pull out box & its cover shall be hot dip galvanized.			
4.05.00	Lighting Wires			
4.05.01	Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminium wire for fixed wiring installation. Colour of the PVC insulation of wires shall be Red, Yellow, Blue and Black for R, Y, B phases & neutral, respectively and white & grey for DC positive & DC negative circuits, respectively. Minimum size of wire shall not be less than 1.5.sq.mm. for copper and 4 sq.mm. for aluminium.			
4.06.00	Lighting Poles			
4.06.01	The Street Light system and peripheral lighting shall be designed generally in line with design guidelines. The Poles shall be mounted above ground using base plate and minimum height of pole shall be 8 mtrs The poles shall be hot-dip galvanized as per IS2629/ IS2633/ IS4759. The average coating thickness of galvanizing shall be min. 70 micron. The System shall be capable of withstanding the appropriate wind load etc as per IS 875 considering prevailing soil/ site condition considering all accessories mounting on pole. The street light poles shall have loop in loop out arrangement for cable entry and light fixture / wiring protected with suitably rated MCB.			
4.07.00	Occupancy based Passive Infra-red sensors The sensors shall be recess mounted, programmable type suitable for lighting load of 6A with variable off delay settings. The detection area shall be minimum 5 metres for standard room height of 3mt. All the calibrated settings shall be stored in non-volatile memory of PIR sensor which shall be unaffected by power supply fluctuations. Necessary 16A contactor shall be supplied alongwith each sensor & shall be located inside the switch box			
5.00.00	TESTS			
5.01.00	For LED Fixture a) All equipments to be supplied shall be of type tested design. During detailed engineering, 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 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. b) However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client /Employers representative and submit the reports for approval.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUBSECTION-II-E15 STATION LIGHTING	Page 11 of 16

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC							
5.02.00	c) 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.										
	d) 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.										
	LED fixtures Type test reports to be submitted for one rating each of following type of LED fixtures.										
	a) High bay fixture.										
	b) Well glass fixture.										
	c) Street light fixture										
	d) Surface mounted type fixture.										
	e) Recessed mounted type fixture.										
	For all other lighting equipment:										
	a) All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner'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 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.										
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5.03.00	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.										
5.04.00	Selection of samples for type test, acceptance test & routine test and acceptance criteria for all the items shall be as per relevant IS										
5.05.00	Type test reports of the following items as per technical specification requirements/ standards shall be submitted for approval.										
<table><tr><th>SL NO.</th><th>DESCRIPTION</th></tr><tr><td>i.</td><td>Lighting fixtures of each type</td></tr><tr><td>ii.</td><td>Lighting panel of each type (Degree of Protection)</td></tr><tr><td>iii.</td><td>Junction Box of each type.</td></tr></table>				SL NO.	DESCRIPTION	i.	Lighting fixtures of each type	ii.	Lighting panel of each type (Degree of Protection)	iii.	Junction Box of each type.
SL NO.	DESCRIPTION										
i.	Lighting fixtures of each type										
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iii.	Junction Box of each type.										
Type test reports for LED as per standards for following shall be submitted for approval.											
<table><tr><td>1. Visual and Dimension check</td></tr><tr><td>2. Proof of procurement of LEDs</td></tr><tr><td>3. Safety tests</td></tr><tr><td> a) Marking</td></tr><tr><td> b) Construction</td></tr><tr><td> c) Provision for Earthing</td></tr></table>				1. Visual and Dimension check	2. Proof of procurement of LEDs	3. Safety tests	a) Marking	b) Construction	c) Provision for Earthing		
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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(1A)-2	SUBSECTION-II-E15 STATION LIGHTING	Page 12 of 16							

CLAUSE NO.		TECHNICAL REQUIREMENTS																												
		<table border="1"><tr><td>d) External and Internal wiring</td></tr><tr><td>e) Protection against electrical shock</td></tr><tr><td>f) Endurance and Thermal</td></tr><tr><td>g) Insulation resistance & electrical strength</td></tr><tr><td>h) Resistance to heat fire & tracking</td></tr><tr><td>i) Resistance to Humidity</td></tr><tr><td>4. Fire Retardant test</td></tr><tr><td>5. Performance tests (electrical, Photometric color and Life)</td></tr><tr><td>6. Burn-in Test</td></tr><tr><td>7. Power Cycling</td></tr><tr><td>8. Temperature rise test</td></tr><tr><td>9. Emission Tests</td></tr><tr><td> a) Radiated & conducted emission</td></tr><tr><td> b) Harmonics & flickers</td></tr><tr><td>10. Immunity tests</td></tr></table>				d) External and Internal wiring	e) Protection against electrical shock	f) Endurance and Thermal	g) Insulation resistance & electrical strength	h) Resistance to heat fire & tracking	i) Resistance to Humidity	4. Fire Retardant test	5. Performance tests (electrical, Photometric color and Life)	6. Burn-in Test	7. Power Cycling	8. Temperature rise test	9. Emission Tests	a) Radiated & conducted emission	b) Harmonics & flickers	10. Immunity tests										
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		In addition, following test reports to be submitted for LED chip/LED luminaire: a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer. b) LM 80/IS: 16105 report. c) LM 79/IS: 16106 report.																												
5.06.00	Acceptance Test and Routine Test																													
5.06.01	All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards.																													
5.06.02	Junction boxes, switch boxes, receptacle enclosure etc. shall be subjected to physical and dimensional checks also. Switch boxes shall be made of 1.6 mm thick MS sheet with 3 mm thick decorative, Perspex cover. Switch box shall be hot dip galvanized.																													
		Switch boxes shall be of following types :																												
		<table><tr><th>TYPE No.</th><th>Switch</th><th>Fan Regulator*</th><th>Socket</th></tr><tr><td>SWB 1</td><td>5 A - 2 Nos.</td><td>-</td><td>-</td></tr><tr><td>SWB 2</td><td>5 A - 3 Nos.</td><td>-</td><td>5A - 1.No.</td></tr><tr><td>SWB 3*</td><td>5 A - 5 Nos.</td><td>1</td><td>5A - 1.No</td></tr><tr><td>SWB 4*</td><td>5 A - 7 Nos</td><td>3</td><td>5A - 1.No.</td></tr><tr><td>SWB 5**</td><td>5 A - 5 Nos</td><td>-</td><td>5A - 1.No.</td></tr></table>				TYPE No.	Switch	Fan Regulator*	Socket	SWB 1	5 A - 2 Nos.	-	-	SWB 2	5 A - 3 Nos.	-	5A - 1.No.	SWB 3*	5 A - 5 Nos.	1	5A - 1.No	SWB 4*	5 A - 7 Nos	3	5A - 1.No.	SWB 5**	5 A - 5 Nos	-	5A - 1.No.	
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SWB 4*	5 A - 7 Nos	3	5A - 1.No.																											
SWB 5**	5 A - 5 Nos	-	5A - 1.No.																											
		* Space provision shall be kept for fan regulator in switch boxes. ** Shall have the provision for mounting the 16 A contactor.																												
5.07.00	Galvanizing Tests																													
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUBSECTION-II-E15 STATION LIGHTING		Page 13 of 16																								

CLAUSE NO.	 TECHNICAL REQUIREMENTS		
5.07.01	The quality of galvanizing shall be smooth, continuous, free from flux stains and shall be inspected visually.		
5.07.02	In addition following tests shall be conducted as acceptance tests.		
	(a) Uniformity of coating - The coating of any article shall withstand for one (1) minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.		
	(b) The quality of cadmium/zinc plating on items with screw threads shall be free from visible defects such as unplated areas, blisters and modules and shall be inspected visually.		
	(c) In addition, the plating thickness shall be determined microscopically/ chemically or electronically.		
6.00.00	COMMISSIONING CHECKS 1. On completion of installation work, the Contractor shall request the Project manager for inspection and test with minimum of fourteen (14) days advance notice. 2. The Project manager shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor. 3. The installation shall be then tested and commissioned in presence of the Project manager. 4. The contractor shall provide all, men material and equipment required to carry out the tests. 5. All rectifications, repair or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the Contractor without any extra cost. The handing over the lighting installation shall be effected only after the receipt of written instruction from the Employer/his authorized representative. 6. The testing shall be done in accordance with the applicable Indian Standards and codes of practices. The following tests shall be specifically carried out for all lighting installation. (a) Insulation Resistance. (b) Testing of earth continuity path. (c) Polarity test of single phase switches. (d) Functional checks. 7. The lighting circuits shall be tested in the following manner: (a) All switches ON and consuming devices in circuit, both poles connected together to obtain resistance to earth. (b) Insulation resistance between poles with lamps and other consuming devices removed and switches ON.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2	SUBSECTION-II-E15 STATION LIGHTING Page 14 of 16

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	ANNEXURE-A				
	SI No.	Location**	Average Illumination Level (Lux)	Type of Fixture	
	(a)	Switchgear rooms, Charger, Rectifier room	200	Industrial type LED Luminaire	
	(b)	Control room, computer room, control equipment room	350	LED luminaire equivalent to Mirror optics with anti-glare features or downlighter.	
	(c)	Offices, conference rooms, etc.	300	Decorative mirror optics Type LED luminaire or LED downlighter	
	(d)	Battery rooms	100	totally enclosed corrosion Proof LED Luminaire	
	(e)	Transformer Area	20 (general) 50 (on equipment)	LED Luminaire	
	(f)	Diesel generating room /enclosure, Compressor room, pump house etc.	150	LED medium bay/ Industrial type LED Luminaire	
	(g)	Cable galleries/vault	50	Industrial type LED Luminaire	
	(h)	Street lighting- primary roads secondary roads	20 10	LED street lights	
	(i)	Outdoor storage handling and unloading area	20	LED Luminaire	
	(j)	Cement stores	150	Industrial dust proof type LED Luminaire	
	(k)	Chemical stores/House	150	Corrosion proof LED Luminaire	
	(l)	Permanent stores	150	LED high/medium bay / Industrial trough LED Luminaire	
	(m)	Workshop. Building	150	LED high/medium bay / Industrial trough LED Luminaire	
	(n)	Laboratory General Analysis area	150 300	Corrosion proof LED Luminaire	
(o)	Garage/Car Parking	50	Industrial type LED Luminaire		
LOT-1A PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUBSECTION-II-E15 STATION LIGHTING	Page 15 of 16

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(p)	Transfer points, Sheds, tunnels, bunker house, Conveyor Gallery etc. in bidders scope	100	LED Dust tight/Well glass type Luminaire
	(q)	Facility building, canteen etc.	150	Industrial type LED Luminaire
	(r)	Corridors, Walkways	50	LED Luminaire
	(s)	Building Periphery Lighting	10	LED Street Light fixture
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(1A)-2		SUBSECTION-II-E15 STATION LIGHTING
Page 16 of 16				

SUB-SECTION-II-E16

BATTERY

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		
1.00.00	BATTERY AND DC HEALTH MONITORING SYSTEM		
	BATTERY RATINGS		
1.01.00	1. For Ni-Cd Type Battery		
	a)	Battery Voltage	220V/125/110V/48 V DC
	b)	No. of Cells	As per Sizing Calculations
	c)	Battery type	Stationary Nickel-Cadmium Pocket Plate High discharge type (KPH)
	d)	Capacity for five(5)hour rate	As per requirement
	e)	Nominal discharge voltage per Cell	1.2 V
	f)	Float voltage	As per manufacturer's standards for float application
	2. For Lead Acid Plante type Battery		
	a)	Battery Voltage	220V/125/110V/48 V DC
	b)	No. of Cells	As per Sizing Calculations
	c)	Battery type	Stationary Lead Acid Plante high discharge type
	d)	Capacity for ten(10)hour rate	As per requirement
	e)	Nominal voltage per cell discharge	2.0 V
	f)	Float Voltage	As per manufacturer's standards for float application
	Note: DC health monitoring system shall be offered integral with each battery set for Main Plant & Switchyard batteries.		
	Commissioning of Battery		
	Commissioning of each battery at site shall only be carried out either by the battery manufacturer himself or under the supervision of the battery manufacturer.		
	LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2
			PAGE 1 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(c.)	Batteries should be suitable for continuous operation for the maximum ambient temperature as defined in technical parameters.		
3.02.00	Construction Features			
3.02.01	Containers			
	Containers shall be made of polypropylene plastic material. Containers shall be robust, heat resistance, leak proof, non absorbent, alkali resistant, non-bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of translucent containers.			
3.02.02	Vent Plugs			
	Vent plugs shall be provided in each cells. They shall be anti-splash type, having more than one exit hole shall allow the gases to escape freely but shall prevent alkali from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition the ventilator shall be easily removed for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte samples.			
3.02.03	Plates			
	The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS 10918.			
	The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion.			
	The positive and negative terminal posts shall be clearly marked.			
3.02.04	Sediment Space			
	Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.			
3.02.05	Electrolyte			
	The electrolyte shall be prepared from battery grade potassium hydroxide conforming to IEC 60993.			
	The cells can be shipped either in charged condition or in dry condition.			
	Necessary electrolyte for make-up shall be supplied separately.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2		SUB-SECTION II-E-16 BATTERY AND DC HEALTH MONITORING SYSTEM
PAGE 3 OF 13				

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
4.00.00	(e.) Serial number THE FOLLOWING INFORMATION SHALL BE GIVEN ON THE INSTRUCTION CARDS SUPPLIED WITH THE BATTERY: (a.) Manufacturer's instructions for filling and initial charging of the battery together with starting and finishing charging rate. (b.) Maintenance instructions. (c.) Designation of cell in accordance with IS 10918. (d.) Storing conditions of electrolyte.		
5.00.00 5.01.00 5.02.00 5.03.00 5.04.00 5.05.00	TESTS All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner'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 techno-commercial bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However, if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of techno-commercial bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval. 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. 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. GENERAL The Contractor shall submit for Owner's approval the reports of all the type tests carried out as per latest IS-1146 (for all applicable tests for containers) / IS-10918 (for Ni-Cd batteries). The complete type test reports shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-16 BATTERY AND DC HEALTH MONITORING SYSTEM	PAGE 5 OF 13

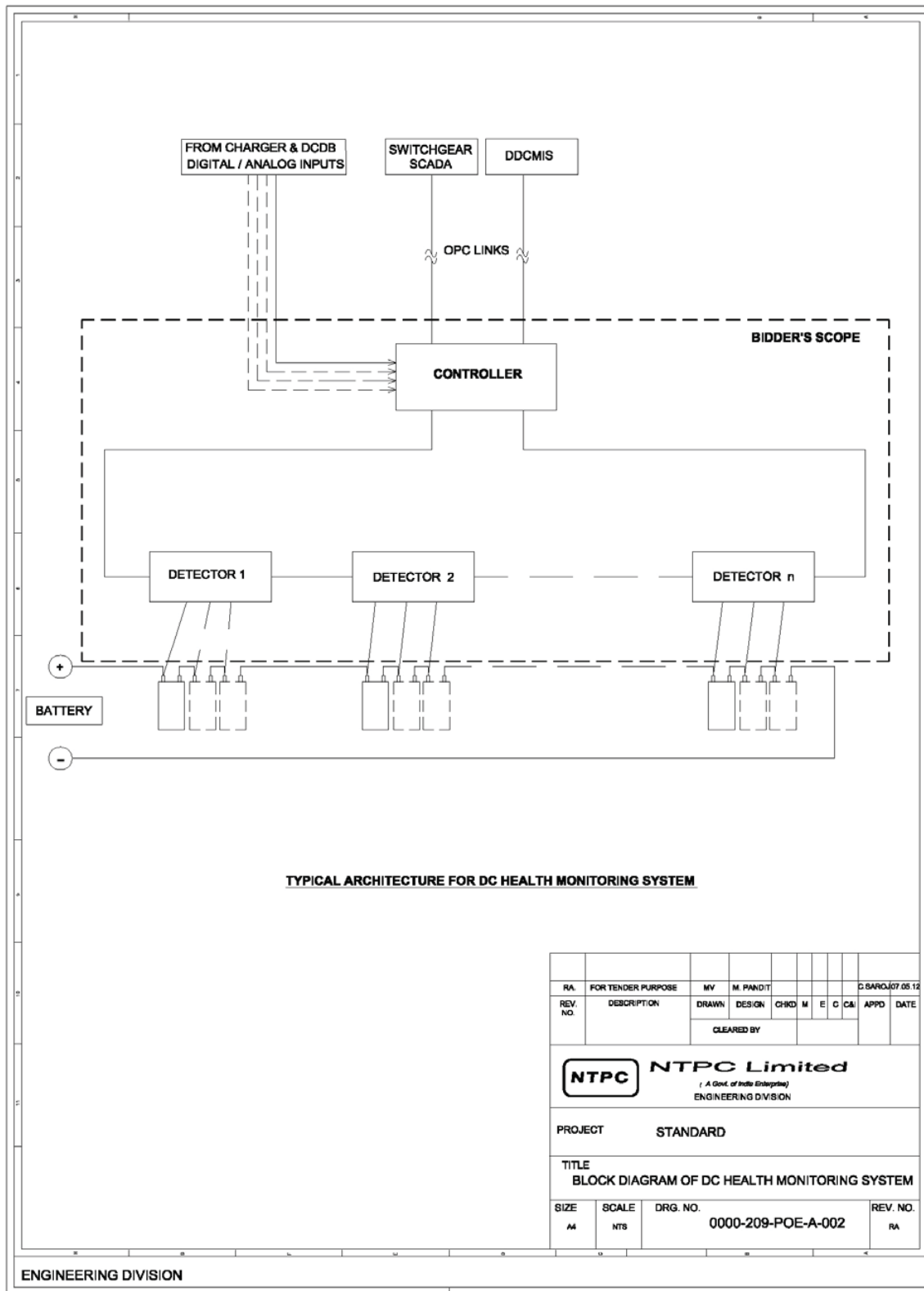
CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.06.00	Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of battery.			
5.07.00	Commissioning Checks: All tests as listed below shall be carried out on sample cell selected at random by the employer at site after completion of installation. (a.) Physical Examination (b.) Dimensions, Mass & layout (c.) MARKING (d.) Polarity and absence of short circuit. (e.) Ampere - hour capacity--4 Cycles (f.) Retention of charge (g.) Insulation resistance The Contractor shall arrange for all necessary equipment, including the variable resistor, tools, tackles and instruments.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-16 BATTERY AND DC HEALTH MONITORING SYSTEM	PAGE 6 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
7.00.00	GENERAL TECHNICAL REQUIREMENTS			
7.01.00	Equipments DC Batteries shall be stationary lead acid Plante positive plate type conforming to IS 1652. The battery shall be high discharge performance type. For the purpose of design an ambient temperature of 50 degree centigrade and relative humidity of 85% shall be considered. DC Batteries shall be suitable for standby duty. The Batteries shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 2.7 volts per cell maximum and float charged at about 2.25 V/cell: Batteries should be suitable for continuous operation for the maximum ambient temperature as defined in technical parameters.			
7.02.00	Construction Features			
7.02.01	Containers Containers shall be made of transparent glass, hard rubber, suitable robust, heat resistance, leak proof, non absorbent, acid resistant, non-bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of transparent containers. Float type level indicator shall be provided in case of opaque containers. The stem portion of the float should be long enough to prevent falling of the float inside the container even if there is no electrolyte in the container. The marking for the electrolyte level should be for the upper and lower limits. The material of level indicator shall be acid proof and oxidation proof. Container shall be closed/sealed lid type. Lid and sealing compound shall be non-cracking type. The container made of hard rubber and plastics shall be type tested as per IS 1146. All type tests shall be carried out for sealing compound as per IS 3116. The pole sealing arrangement should be such that no acid particle get entrapped due to acid creep as a result of capillary action and it should be possible to remove and refix the sealing to carry out the maintenance.			
7.02.02	Vent Plugs Vent plugs shall be provided in each cells. They shall be anti-splash type, having more than one exit hole shall allow the gases to escape freely but shall prevent acid from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition the ventilator shall be easily removed for topping up the			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-16 BATTERY AND DC HEALTH MONITORING SYSTEM	PAGE 8 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS				
7.02.03	cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte sample.				
	Plates The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS 1652 as applicable. The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion. The positive and negative post shall be clearly marked.				
7.02.04	Sediment Space Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.				
7.02.05	Cell Insulator Each cell shall be separately supported on PVC/porcelain/hard rubber insulators fixed on the racks with adequate clearance between adjacent cells. Minimum distance between adjacent cells shall be more than the bulge allowed for two cells in accordance with IS 1146.				
7.02.06	Electrolyte The electrolyte shall be prepared from battery grade sulphuric acid conforming to IS 266 and distilled water conforming to IS 1069. The cells shall be shipped dry uncharged. The electrolyte shall be supplied separately.				
7.02.07	Connectors and Fasteners Lead or Lead coated copper connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion. The thickness of lead-coating of connectors should not be less than 0.025 mm. The lead coating thickness shall be measured in accordance with APPENDIX F of IS 6848 (latest edition). All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds. End take off connections from positive and negative poles of batteries shall be made by single core cables having stranded copper conductors and PVC insulation. Necessary supports and lugs for termination of these cables on batteries shall also be supplied by the contractor. All connectors and lugs shall be capable of continuously carrying the 30 minutes discharge current of the respective Batteries and through fault short circuit current which the battery				
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2		SUB-SECTION II-E-16 BATTERY AND DC HEALTH MONITORING SYSTEM	PAGE 9 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.02.08	can produce and withstand for the period declared. Contractor shall furnish necessary sizing calculations to prove compliance to the same.			
	Battery racks			
7.02.09	Wooden racks for all the batteries shall be provided. These racks shall be made of good quality first class seasoned teak wood in line with CPWD specification. They shall be free standing type mounted on porcelain/hard rubber/PVC pads insulators/High impact plastic insulators. Batteries shall preferably be located in the single tier arrangement. However, batteries having a complete cell weight of lower than 50 Kg could be located in the double tier arrangement. The batteries rack and wooden support for cable termination shall be coated with three (3) coats of anti-acid paint of approved shade. Numbering tags, resistant to acid, for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor. Wherever racks are transported in dismantled condition, suitable match markings shall be provided to facilitate easy assembly.			
	Manufacturer's Identification Systems			
	The following information shall be indelibly marked on outside of each cell.			
	(a.) Manufacturer's name and trade marks			
	(b.) Country and year of manufacture.			
	(c.) Manufacturer type designation.			
8.00.00	(d.) AH capacity at 10 hour discharge rate.			
	(e.) Serial number			
	TESTS			
8.01.00	All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner'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 techno-commercial 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.			
8.02.00	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of techno-commercial bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2		SUB-SECTION II-E-16 BATTERY AND DC HEALTH MONITORING SYSTEM
PAGE 10 OF 13				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.03.00	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.			
8.04.00	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.			
8.05.00	GENERAL The Contractor shall submit for Owner’s approval the reports of all the type tests carried out as per latest IS-1146 (for rubber & plastic containers for lead-acid storage batteries)/IS 1652 (for lead-acid plante batteries). The complete type test reports shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.			
8.06.00	Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of battery.			
8.07.00	Commissioning Checks: All tests as listed below shall be carried out on sample cell selected at random by the employer at site after completion of installation. 1) Verification of markings. 2) Verification of dimensions. 3) Test for capacities for 10 hrs discharge rate alongwith the test for voltage during discharge. The Contractor shall arrange for all necessary equipment, including the variable resistor, tools, tackles and instruments.			
9.00.00	DC HEALTH MONITORING SYSTEM			
9.01.00	DC Health Monitoring System shall include microprocessor based hardware and software to monitor the condition of each battery cell of 220V DC systems battery banks on-line on 24x7 basis. With DC Health Monitoring System it shall be possible to measure & analyse the individual cell and battery parameters so that any damage to battery shall be prevented by pro-active maintenance. A typical Architecture is shown in Drg. No. 0000-209-POE- A-002. Each Battery set shall have its own independent DC Health Monitoring System.			
9.02.00	DC Health Monitoring System shall measure and store the following parameters at pre-determined time interval as decided by the employer during detail engineering: a) Each Cell Voltage			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-16 BATTERY AND DC HEALTH MONITORING SYSTEM	PAGE 11 OF 13



SUB-SECTION-II-E17

BATTERY CHARGER

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																																	
	BATTERY CHARGER																																	
1.00.00	CODES AND STANDARDS																																	
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of techno-commercial bid. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards and codes. <table><tr><td>ANSI-C 37.90a</td><td>Guide for surge withstand capability tests</td></tr><tr><td>IS:5</td><td>Colours for ready mix paints.</td></tr><tr><td>IS : 694</td><td>PVC Insulated Cable for working voltages upto and including 1100 V.</td></tr><tr><td>IS : 1248</td><td>Specification for Direct acting indicating analogue electrical measuring instruments.</td></tr><tr><td>IS:13947 Part-1</td><td>Degree of protection provided by enclosures for low voltage switch gear and control gear.</td></tr><tr><td>IS : 13947</td><td>Specification for low voltage switch gear and control gear</td></tr><tr><td>IS : 3231</td><td>Electrical relays for power system protection.</td></tr><tr><td>IS : 3842</td><td>Application guide for Electrical relays for AC System</td></tr><tr><td>IS : 3895</td><td>Mono-crystalline semi-conductor Rectifier Cells and Stacks</td></tr><tr><td>IS : 4540</td><td>Mono crystalline semi-conductor Rectifier assemblies and equipment.</td></tr><tr><td>IS:6005</td><td>Code of practice for phosphating of Iron and Steel.</td></tr><tr><td>IS:6619</td><td>Safety Code for Semi-conductor Rectifier Equipment.</td></tr><tr><td>IS:6875</td><td>Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto 1000 V AC or 1200 V DC.</td></tr><tr><td>IS : 9000</td><td>Basic environmental testing procedures for electronic and electrical items.</td></tr><tr><td>IS:13703</td><td>Low voltage fuses for voltages not exceeding 1000 V AC or 1500 V DC.</td></tr></table>				ANSI-C 37.90a	Guide for surge withstand capability tests	IS:5	Colours for ready mix paints.	IS : 694	PVC Insulated Cable for working voltages upto and including 1100 V.	IS : 1248	Specification for Direct acting indicating analogue electrical measuring instruments.	IS:13947 Part-1	Degree of protection provided by enclosures for low voltage switch gear and control gear.	IS : 13947	Specification for low voltage switch gear and control gear	IS : 3231	Electrical relays for power system protection.	IS : 3842	Application guide for Electrical relays for AC System	IS : 3895	Mono-crystalline semi-conductor Rectifier Cells and Stacks	IS : 4540	Mono crystalline semi-conductor Rectifier assemblies and equipment.	IS:6005	Code of practice for phosphating of Iron and Steel.	IS:6619	Safety Code for Semi-conductor Rectifier Equipment.	IS:6875	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto 1000 V AC or 1200 V DC.	IS : 9000	Basic environmental testing procedures for electronic and electrical items.	IS:13703	Low voltage fuses for voltages not exceeding 1000 V AC or 1500 V DC.
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LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-17 BATTERY CHARGER	PAGE 1 OF 13																														

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
1.02.00	EEUA-45D	Performance requirements for electrical Alarm Annunciation System		
		Indian Electricity Rules		
		Indian Electricity Act.		
	Equipment complying with other internationally accepted standards such as IEC, BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of techno-commercial bid and shall clearly bring out the salient features for comparison.			
2.00.00	EQUIPMENT DESCRIPTION			
2.01.00	PART-I BATTERY CHARGER FOR LEAD ACID PLANTE TYPE BATTERY			
	(a.) The Battery Chargers as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC lead-acid Batteries while supplying the D.C. loads. The Batteries shall be Trickle charged at 2.25 Volts per cell. All chargers shall also be capable of Boost Charging the associated D.C. Battery at 2.3 to 2.7 Volts per cell at the desired rate. The Chargers shall be designed to operate, as mentioned above, at an ambient air temperature of 50°C. (b.) All Battery Chargers shall have provision to receive two input supplies along with suitable automatic changeover between the sources. (c.) Battery Chargers shall have a selector switch for selecting the battery charging mode i.e. whether Trickle or Boost charging. (d.) All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. Means shall be provided to avoid current/voltage surges of harmful magnitude/nature which may arise during changeover from Auto to Manual mode or vice-versa under normal operating condition. (e.) Soft start feature shall be provided to build up the voltage to the set value slowly within fifteen seconds. The chargers shall have load limiters which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the Charger. The load limiter			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2		SUB-SECTION II-E-17 BATTERY CHARGER
PAGE 2 OF 13				

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	characteristic shall be such that any sustained overload or short circuit in DC system shall neither damage the Charger nor shall it cause blowing of any of the charger fuses. The Charger shall not trip on overload or external short circuit. After clearance of fault, the Charger voltage shall build up automatically when working in automatic mode. (f.) When on automatic control mode during Trickle charging, the Charger output voltage shall remain within $\pm 1\%$ of the set value for AC input voltage variation of $\pm 10\%$, frequency variation of $\pm 3\text{--}5\%$, a combined voltage and frequency (absolute sum) variation of 10% and a continuous DC load variation from zero to full load. Uniform and step-less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire Trickle charging output range specified & shall be capable of matching the float voltage correction recommendations(w.r.t. temperature) as suggested by the respective battery manufacturer. Step-less adjustment of the load limiter setting shall also be possible from 80% to 100% of the rated output current for Trickle charging mode. (g.) During Boost charging, the Battery Chargers shall operate on constant current mode (When automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode. The charger output voltage shall automatically go on rising, when it is operating on boost mode, as the battery charges up. For limiting the output voltage of the charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for boost charging mode. All voltage and current setting potentiometers shall be vernier type. (h.) Energizing the Charger with fully charged battery connected plus 10% load shall not result in output voltage greater than 110% of the voltage setting. Time taken to stabilize, to within the specified limits as mentioned elsewhere, shall be less than fifteen seconds. (i.) Momentary output voltage of the Charger, without the Battery connected shall be within 94% to 106% of the voltage setting during sudden load Change from 100% to 20% of full load or vice-versa. Output voltage shall return to, and remain, within the limits specified as mentioned elsewhere in less than 2 seconds after the above mentioned change. (j.) The Charger manufacturer may offer an arrangement in which the voltage setting device for Trickle charging mode is also used as output voltage limit setting device for		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-17 BATTERY CHARGER	PAGE 3 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.02.00	Boost charging mode, and the load limiter of the trickle charging mode is also used as Boost charging current setting device. (k.) Suitable filter circuits shall be provided in all the Chargers to limit the ripple content (peak to peak) in the output voltage to 1% irrespective of the DC load, even when they are not connected to a battery. (l.) The DC System shall be ungrounded and float with respect to the ground potential when healthy. An earth fault relay shall be provided by the Employer in the DC distribution board for remote annunciation. (m.) Digital Outputs shall be configured for connection to the DC health monitoring system for real-time charger status updation. Outputs like charger output current, output voltage, float/boost mode, etc may be configured.			
	PART-II BATTERY CHARGER FOR NICKEL-CADMIUM TYPE BATTERY (a.) The Battery Chargers as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC Nickel-Cadmium Batteries while supplying the D.C. loads. The Batteries shall be Trickle charged at 1.4 to 1.42 Volts per cell. All chargers shall be capable of Boost Charging the associated D.C. Battery at 1.53 to 1.7 Volts per cell at the desired rate. The Chargers shall be designed to operate, as mentioned above, at an ambient air temperature of 50°C. (b.) All Battery Chargers shall have provision to receive two input supplies along with suitable automatic changeover between the sources. (c.) Battery Chargers shall have a selector switch for selecting the battery charging mode i.e. whether Trickle or Boost charging. (d.) All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. Means shall be provided to avoid current/voltage surges of harmful magnitude/nature which may arise during changeover from Auto to Manual mode or vice-versa under normal operating condition. (e.) Soft start features shall be provided to build up the voltage to the set value slowly within fifteen seconds. The chargers shall have load limiters which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the Charger. The load limiter			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-17 BATTERY CHARGER	PAGE 4 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	characteristic shall be such that any sustained overload or short circuit in DC system shall not damage the Charger, nor shall it cause blowing of any of the charger fuses. The Charger shall not trip on overload or external short circuit. After clearance of fault, the Charger voltage shall build up automatically when working in automatic mode. (f.) When on automatic control mode during Trickle charging, the Charger output voltage shall remain within +/-1% of the set value for AC input voltage variation of +/-10%, frequency variation of +3 to -5%, a combined voltage and frequency (absolute sum) variation of 10% and a continuous DC load variation from zero to full load. Uniform and stepless adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire Trickle charging output range specified & shall be capable of matching the float voltage correction recommendations(w.r.t. temperature) as suggested by the respective battery manufacturer. Stepless adjustment of the load limiter setting shall also be possible from 80% to 100% of the rated output current for Trickle charging mode. (g.) During Boost charging, the Battery Chargers shall operate on constant current mode (When automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode. The charger output voltage shall automatically go on rising, when it is operating on boost mode, as the battery charges up. For limiting the output voltage of the charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for boost charging mode. All voltage and current setting potentiometers shall be vernier type. (h.) Energising the Charger with fully charged battery connected plus 10% load shall not result in output voltage greater than 110% of the voltage setting. Time taken to stabilise, to within the specified limits as mentioned elsewhere shall be less than fifteen seconds. (i.) Momentary output voltage of the Charger, without the Battery connected shall be within 94% to 106% of the voltage setting during sudden load Change from 100% to 20% of full load or vice-versa. Output voltage shall return to, and remain, within the limits specified as mentioned elsewhere in less than 2 seconds after the above mentioned change. (j.) The Charger manufacturer may offer an arrangement in which the voltage setting device for Trickle charging mode is also used as output voltage limit setting device for Boost charging mode, and the load limiter of the trickle charging mode is also used as Boost charging current setting device.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-17 BATTERY CHARGER	PAGE 5 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(k.) Suitable filter circuits shall be provided in all the Chargers to limit the ripple content (peak to peak) in the output voltage to 1% irrespective of the DC load, even when they are not connected to a battery. (l.) The DC System shall be ungrounded and float with respect to the ground potential when healthy. An earth fault relay shall be provided by the Employer in the DC distribution board for remote annunciation. (m.) Digital Outputs shall be configured for connection to the DC health monitoring system for real-time charger status updation. Outputs like charger output current, output voltage, float/boost mode, etc may be configured.			
2.03.00	Printed Circuits Boards (PCB) PCB shall be made of glass epoxy of 1.6 mm thick, fire resistant, bonded with 99.8% pure copper foil, free of wrinkles, blisters, scratches and pinholes. The contact surface of the edge connectors of the PCBs shall be plated with hard gold to a minimum thickness of 5 microns. Component identification shall be printed on PCB by silk screen method. All PCBs shall be tropicalised and masked.			
2.04.00	CONTACTORS All Battery Chargers shall have an AC contactor on the input side. It shall be of air break type and suitable for continuous duty. The operating coil shall be rated for 415 Volts AC.			
2.05.00	Thermal Overload Relay A thermal overload relay incorporating a distinct single phasing protection (using differential movement of bimetal strips) shall also be provided for the AC input. The relay shall trip the above contactor.			
2.06.00	Rectifier-Transformers and Chokes The rectifier transformer and chokes shall be dry and air cooled (AN) type. The rating of the rectifier-transformers and chokes shall correspond to the rating of the associated rectifier assembly. The rectifier-transformers and chokes shall have class-B insulation with temperature rise limited to class-A insulation value.			
2.07.00	Rectifier Assembly The rectifier assembly shall be full wave bridge type and designed to meet the duty as required by the respective Charger. The rectifier cells shall be provided with their own heat dissipation arrangement with natural air cooling for up to 400A rating chargers. However, the rectifier cells shall be provided with their own heat dissipation arrangement along with forced air cooling for above 400A rating chargers and fan shall be temperature controlled with 100%			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2		SUB-SECTION II-E-17 BATTERY CHARGER
PAGE 6 OF 13				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	standby redundancy. The rectifier shall utilise diodes/thyristors and heat sinks rated to carry 200% of the load current continuously and the temperature of the heat sink shall not be permitted to exceed 85°C absolute duly considering the maximum charger panel inside temperature. The Contractor shall submit calculations to show what maximum junction temperature will be and what the heat sink temperature will be when operating at 200% and 100% load current continuously duly considering the maximum surrounding air temperature for these devices inside the charger panel assuming air ambient temperature of 50°C outside the panel. Necessary surge protection devices and rectifier type fast acting fuses shall be provided in each arm of the rectifier connections.			
2.08.00	DIGITAL INDICATING INSTRUMENTS Digital indicating instruments with built in communication port for remote data transfer shall be provided for all chargers. The instruments shall indicate DC current, DC voltage & AC voltage and instrument shall be 96 x 96 mm², with display accuracy 0.5%, 4 digit-7 segment LED/LCD display and RS 485 Serial Bus port.			
2.09.00	AIR BREAK SWITCHES All Chargers shall have AC input and DC output switches of air break, single throw, load break and fault make type. The contacts of the switches shall open and close with a snap action. Switches shall be rated for 120% of the maximum continuous load. 'ON' & 'OFF' position of the switch shall be clearly indicated.			
2.10.00	CONTROL AND SELECTOR SWITCHES Control and selector switches shall be of rotary stayput type with escutcheon plates showing the functions and positions. The switches shall be of sturdy construction and suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred. The contact ratings shall be atleast the following: (a.) Make and carry continuously – 10 Amps. (b.) Breaking current at 220 V DC – 0.5 Amp. (inductive) (c.) Breaking current at 240 V AC – 5 Amp. At 0.3 p.f.			
2.11.00	FUSES Fuses shall be of HRC cartridge fuse link type. Fuses shall be mounted on fuse carriers which are mounted on fuse bases. Wherever it is not possible to mount fuses on fuse carriers, fuses shall be directly mounted on plug in type bases. In such cases one insulated fuse pulling handle shall be supplied for each charger. Kick-off fuses (trip fuses) with alarm contacts shall be provided for all D.C. fuses.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2		SUB-SECTION II-E-17 BATTERY CHARGER
PAGE 7 OF 13				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.12.00	Indicating Lamps Three (3) indicating lamps shall be provided to indicate A.C. supply availability. The indicating lamp shall be of panel mounting, filament type low wattage or LEDs and capable of clear status indication under the normal room illumination. The lamps shall be provided with series resistors (non-hygroscopic) preferably built in the lamp assembly and replaceable from front. The lamp covers shall be preferably screwed type, unbreakable and moulded from heat resistant material			
2.13.00	Blocking Diode Blocking diode shall be provided in the output circuit of each Charger to prevent current flow from the D.C. Battery into the Charger.			
2.14.00	Annunciation System Visual indications through indicating lamps/LEDs or annunciation fascia shall be provided in all Chargers for the following: (a.) A.C. supply failure (b.) Rectifier fuse failure (c.) Surge circuit fuse failure (d.) Filter fuse failure (e.) Load limiter operated (f.) Charger trip (g.) Battery on Boost Potential free NO contacts of all above conditions shall be provided for following remote alarms in the Employer's Unit Control Board: (a) Battery on Boost (b) Charger trouble (this being a group alarm initiated by any of the faults other than 'Battery on Boost')			
2.15.00	Name Plates and Marking The name plates shall be made of non-rusting metal/3 ply Lamicoid and shall have black back-ground with white engraved letters and secured by screws. These shall be provided near top edge on the front as well as on rear side of Charger. Name plates with full and clear			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-17 BATTERY CHARGER	PAGE 8 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	inscriptions shall also be provided on and inside the panels for identification of the various equipments.			
3.00.00	CONSTRUCTION			
3.01.00	The Chargers shall be indoor, floor mounted, self supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Charger shall be fabricated using cold rolled sheet steel shall not less than 1.6 mm and shall have folded type of construction. The panel frame shall be fabricated using cold rolled sheet steel of thickness not less than 2.0 mm. Removable undrilled gland plates of at least 3.0 mm sheet steel and lugs for all cables shall be supplied by the Contractor. The lugs for cables shall be made of electrolytic copper with tin coat. Cable sizes shall be advised to the Contractor at a later date for provision of suitable lugs and gland plates. The Charger shall be tropicalised and vermin proof. Ventilation louvers shall be backed with fine brass wire mesh. All doors and covers shall be fitted with synthetic rubber gaskets. The Chargers shall have hinged double leaf doors provided on front and/or backside for adequate access to the Charger internals. All the Charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be atleast IP-42.			
3.02.00	All indicating instruments, control & selector switches and indicating lamps shall be mounted on the front side of the Charger. Design of panels shall be based on the following dimensions.			
	1)	Overall height	-	Maximum 2350 mm
	2)	Operating handles	-	Maximum 1800 mm
		(highest and lowest positions reached by operator's hands),		Minimum 350 mm
		protective mechanical indicators		
	3)	Doors and panel	-	Maximum 1800 mm
		handles and locks		Minimum 300 mm
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2		SUB-SECTION II-E-17 BATTERY CHARGER
PAGE 9 OF 13				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.03.00	The layout of Charger components shall be such that their heat losses do not give rise to excessive temperature within the Charger panel surface. Location of the electronic modules will be such that temperature rise of the location, in no case, will exceed 10°C over ambient air temperature outside the Charger.			
3.04.00	Each Charger panel shall be provided with an illuminating lamp and one 5 Amp. Socket. Switches and fuses shall be provided separately for each of the above.			
3.05.00	Locking facilities shall be provided as following: 1. For locking Trickle/Boost selector switch in the respective position. 2. The Charger enclosure door locking requirements shall be met by the application of padlocks. Padlocking arrangement shall allow ready insertion of the padlock shackle but shall not permit excessive movement of the locked parts with the padlock in position.			
3.06.00	Wiring			
3.06.01	Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks ready for external connection. The power wiring shall be carried out with 1.1 KV grade PVC insulated cables conforming to IS:1554 (Part-I). The control wiring shall be of 1.1KV grade PVC insulated stranded copper conductors of 2.5 sq.mm. conforming to IS:694. Control wiring terminating at electronic cards shall not be less than 1.0 sq. mm. Control terminal shall be suitable for connecting two wires with 2.5 sq.mm. stranded copper conductors. All terminals shall be numbered for ease of connections and identification. At least 20% spare terminals shall be provided for circuits.			
3.06.02	Power and control wiring within panels shall be kept separate. Any terminal or metal work which remains alive at greater than 415 V, when panel door is opened, shall be fully protected by shrouding.			
3.06.03	An air clearance of at least ten (10) mm shall be maintained throughout all circuits, except low voltage electronic circuits, right upto the terminal lugs. Whenever this clearance is not available, the live parts should be insulated or shrouded.			
3.07.00	PAINTING Treatment as per IS:6005. Two coats of lead oxide primer followed by powder painting with final shade of RAL9002 for complete panel except end covers & RAL 5012 for end covers.			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2		SUB-SECTION II-E-17 BATTERY CHARGER
PAGE 10 OF 13				

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.00.00	TESTS			
4.01.00	All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner'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 techno-commercial 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.			
4.02.00	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of techno-commercial bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.			
4.03.00	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.			
4.04.00	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.			
4.05.00	GENERAL			
	1. For chargers of rating more than 60A, the contractor shall furnish the following type tests reports for each rating of the equipment to be supplied under this contract. a) Complete physical examination b) Temperature rise test at full load. (For chargers of up to 400A rating, Temperature rise test report for rectifier assembly at 200% of full load shall also be submitted.) c) Insulation resistance test. d) High voltage (power frequency) test on power and control circuits except low voltage electronic circuits. e) Ripple content test at i) No load ii) Half load iii) Full load			
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-17 BATTERY CHARGER	PAGE 11 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	f) Automatic voltage regulator operation test at specified A.C. supply variations at i) No load ii) Half load iii) Full load g) Load limiter operation test h) Efficiency and power factor measurement. i) Surge withstand capability test at the following points of the Charger: i) Across each A.C. input phase ii) Across AC input line to ground. iii) Across D.C. output terminals. iv) Across each D.C. output terminal to ground The Charger shall not exhibit any component damage and there shall be no change in performance as per (g) and (h). j) Environmental Tests Steady state performance tests (f) and (g) shall be carried out before and after each of the following tests. i) Soak Test The electronic modules shall be subjected to continuous operation for a minimum period of 72 hours. During last 48 hours, the ambient temperature shall be maintained at 50 deg. C. The 48 hour test period shall be divided into four equal 12 hour segments. The input voltage during each 12 hours shall be nominal voltage for 11 hours followed by 110% of nominal voltage for 30 minutes, followed by 90% of nominal voltage for 30 minutes. ii) Degree of protection test.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-17 BATTERY CHARGER	PAGE 12 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.00.00 5.01.00	2. Dynamic response test and Temperature rise test at full load shall be carried out on each charger before dispatch at manufacturer's works. COMMISSIONING The contractor shall carryout the following commissioning tests and checks after installation of the equipment at site: a) Complete physical examination. b) Checking of proper operation of annunciation system. c) Insulation resistance test. d) Automatic voltage regulator operation. e) Load limiter operation. f) Updation of charger status in DC Battery Health monitoring system.		
LOT-IA PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC.NO.:CS:0011-109(1A)-2	SUB-SECTION II-E-17 BATTERY CHARGER	PAGE 13 OF 13

NTPC Limited

(A Government of India Enterprise)



LOT 1A PROJECTS

**PART – B
(DETAILED TECHNICAL SPECIFICATION)**

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

SECTION – VI

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

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

PART – B (DETAILED TECHNICAL SPECIFICATION)

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

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

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

SUB-SECTION-III-C1

BASIC DESIGN CRITERIA

**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 
	BASIC DESIGN CRITERIA 1.00.00 GENERAL REQUIREMENTS 1.01.00 The Contractor shall provide Independent Control & Instrumentation system for control, monitoring and operation of associated drives in all regimes of operation in safe and most efficient manner including Primary and Secondary Instruments, Panels/ Desks, Process Connection and Piping, charges & batteries, associated Instrumentation Cables etc. as identified in the specification. 1.02.00 The Contractor shall provide all material, equipment and services so as to make a totally integrated Instrumentation and Control System together with all accessories, auxiliaries and associated equipments ensuring operability, maintainability and reliability. This work shall be consistent with modern power plant practices and shall be in compliance with all applicable codes, standards, guides, statutory regulations and safety requirements in force. 1.03.00 Further Bidder shall also include in his proposal and shall furnish all equipment, devices and services which may not be specifically stated in the specification but are needed for completeness of the equipment/systems furnished by the Bidder and for meeting the intent and requirements of the specification. 1.04.00 Bidder shall include in his bid a detailed Bill of Material (BOM) for each of the systems. 1.05.00 In addition to requirements specified under this Section-VI, Part-B, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification. 2.00.00 RELIABILITY AND AVAILABILITY 2.01.00 Each component and system offered by the Bidder shall be of established reliability. The minimum target reliability of each piece of equipment like each electronic module/card, Power supply, Peripheral etc. shall be established by the Bidder, considering its failure rate/mean time between failures (MTBF), meantime to repair (MTTR), such that the availability of the complete C&I system is assured . 2.02.00 When more than one device uses the same measurement or control signal, the transmitter and other components/ module shall be fully equipped to provide all signal requirements. All the 4-20 mA output signals from transmitters/other control system shall be able to drive minimum 500 Ohms load resistance. The system shall be arranged so that the failure of any monitoring device or control components or spurious intermediate grounding in the signal path shall not open the signal loop nor cause the loss or malfunction of signal to other devices using the same 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-C1 BASIC DESIGN CRITERIA PAGE 1 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
2.03.00	To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level to satisfy the availability criteria mentioned above. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.		
3.00.00	OPERABILITY & MAINTAINABILITY		
3.01.00	The design of the control systems and related equipments shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved. 'Fail Safe' operation signifies that the loss of signal, loss of excitation or failure of any component shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided / minimised .		
3.02.00	The types of failure that shall be taken into account for ensuring operability of the plant shall include but not be limited to: — Failure of sensor or transmitter. — Failure of main and/or redundant controller/other modules. — Loss of motive power to final control element. — Loss of control power. — Loss of instrument air.		
3.03.00	The choice of hardware shall also take into account sound maintainability principles and techniques. The same shall include but shall not be limited to the following: — Standardization of parts. — Minimum use of special tools. — Grouping of functions. — Interchangeability. — Malfunction identification facility/self surveillance facility. — Easy modular replacement. — Fool proof design providing proper identification and other features to preclude improper mounting and installation. — Appropriate de-rating of electronic components and parts.		
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-C1 BASIC DESIGN CRITERIA
PAGE 2 OF 4			

CLAUSE NO.	TECHNICAL REQUIREMENTS				
3.04.00	The equipment shall employ latest state of the art technology to guard against obsolescence. In any case, Bidder shall be required to ensure supply of spare parts for lifetime of the plant. In case, the Bidder feels that certain equipment/component is likely to become obsolete, the Bidder shall clearly bring out the same in his Bid and indicate steps proposed to deal with such obsolescence.				
3.05.00	Control & Monitoring				
3.05.01	The control, monitoring & operation of flue gas desulphurization system shall be as detailed out in Sub-section PLC Based Control system and Sub-section C & I for flue gas desulphurization system. Further, flue gas desulphurization system, link shall be provided for collection of data in the DDCMIS (In Employer's Scope) in UCR for the information of unit-incharge / shift-incharge etc. through Station Wide LAN.				
4.00.00	ENVIRONMENTAL CONDITIONS				
4.01.00	Instruments, devices and equipments for location in outdoors/indoor/air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment of a coal fired utility station and also during periods of air conditioning failure without any loss of function, or departure from the specification requirements covered under this specification.				
	Ambient Temperature (outside cabinets)	Pressure	Relative humidity	Atmosphere	Required protection Class of panels/ cabinets/ desks to be provided by contractor.
	Outdoor Location				
	55 degree C max.	Atmosp here	100 % Max.	Air (dirty)	IP 55
	4 degree C min.	Atmosp here	5 % min.	Air (dirty)	IP 55
	Indoor Location				
	55 degree C max.	Atmosp here	95 % Max	Air	IP 54**
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-C1 BASIC DESIGN CRITERIA	PAGE 3 OF 4

CLAUSE NO.	TECHNICAL REQUIREMENTS					एनटीपीसी NTPC
5.00.00	4 degree C min.	Atmosp here	5 % min.	Air	IP 54**	
	Air Conditioned Areas					
	24 +/- 5 degree C normal	Atmosp here	95 % Max.	Air	IP 22***	
	50 degree C max. *	Atmosp here	5 %min.	Air	IP 22***	
	* During air conditioning failure.					
	** For non-ventilated enclosures. For ventilated enclosures, protection class shall be IP 42.					
	*** With a suitable canopy at the top to prevent ingress of dripping water.					
	For PCs, OWS, EWS, Servers, Printers and other peripherals, maximum temperature limit shall be 35 Deg.C. For mini-UPS, the same shall be 40 Deg.C.					
	GROUNDING SYSTEM					
	All panels, desks, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable). Shield on instrumentation cables shall be grounded on panel side. When shielding termination are required in cabinets furnished under this specification, suitable terminals shall be furnished on copper flat forming system ground. System and shield ground shall be connected to earthing strip using suitable size of cable to be provided by the contractor. The Contractor shall submit with the offer recommended grounding scheme required for his system. The exact grounding scheme shall be finalised during detailed 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-C1 BASIC DESIGN CRITERIA	PAGE 4 OF 4	

SUB-SECTION-III-C2

MEASURING INSTRUMENTS
(PRIMARY AND SECONDARY)

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
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	
2.00.00	SPECIFICATION FOR ELECTRONIC TRANSMITTERS			
2.01.00	SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS			
	SI.No.	Features	Essential/Minimum Requirements	
	1.	Type of Transmitter	Microprocessor based 2 wire type (loop powered), Hart protocol compatible.	
	2.	Accuracy	± 0.1% of calibrated span (minimum)	
	3.	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)	
	4.	Turn down ratio (minimum)	10:1 for vacuum/very low pressure applications (i.e. pressure <= 200 mmWC) 5:1 for very high pressure application (i.e. pressure >= 200 Kg/cm2) 30:1 for other applications	
	5.	Stability	± 0.1% of calibrated span for six months for Ranges up to and including70 Kg/cm² ± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm²	
	6.	Zero and span drift	+/- 0.015% per deg.C at max span +/-0.11% per deg.C at min. Span	
	7.	Load impedance	500 ohm (minimum)	
	8.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistant coating	
	9.	Over Pressure	150% of max. Operating pressure	
	10.	Connection (Electrical)	Plug and socket type	
	11.	Process connection	1/2 inch NPT (F)	
	12.	Span and Zero	Continuous, tamper proof, Remote as well as manual adjustability from instrument with zero suppression and elevation facility.	
	13.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & Gauge pressure transmitters, 3-valve and 5 valve manifold for DP/Level/Flow applications. The valve manifold shall be non integral type (except Fuel Oil area).	
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 2 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.02.00		-For hazardous area, explosions proof enclosure as described in NEC article 500	
		Mounting: 2 inch pipe mounting.	
	14.	Diagnostics & display	Self-Indicating feature and digital display on transmitter
	15.	Power supply	24V DC ± 10%.
	16.	Adjustment/calibration/maintenance	From hand held HART calibrator/ centralized PC based system (as applicable).
	Notes		
	- For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement. - 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.		
	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-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 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 5008 1-2 & 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-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 4 OF 34

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

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
	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
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 7 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC																								
2.05.00	HART Hand Held calibrator Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided for that specific type of transmitter.																										
3.00.00	Temperature Elements and accessories																										
3.01.00	Thermocouple <table><tr><th>Sr. No.</th><th>Features</th><th>Essential/Minimum Requirements</th></tr><tr><td>1</td><td>Type of Thermocouple.</td><td>: 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded separate junction type).</td></tr><tr><td>2</td><td>No. of element</td><td>: Duplex</td></tr><tr><td>3</td><td>Housing/Head</td><td>: IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well.</td></tr><tr><td>4</td><td>Insulation and Sheathing of Thermocouple</td><td>: Swaged type mineral (magnesium oxide) insulation and SS316 sheath.</td></tr><tr><td>5</td><td>Calibration and accuracy</td><td>: As per IEC-584/ ANSI-MC-96.1 (special limits of errors/ class1) for T/C.</td></tr><tr><td>6</td><td>Accessories</td><td>: Thermo well and associated fittings</td></tr><tr><td>7</td><td>Standard</td><td>: IEC-584/ ANSI MC 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well</td></tr></table>			Sr. No.	Features	Essential/Minimum Requirements	1	Type of Thermocouple.	: 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded separate junction type).	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 Thermocouple	: Swaged type mineral (magnesium oxide) insulation and SS316 sheath.	5	Calibration and accuracy	: As per IEC-584/ ANSI-MC-96.1 (special limits of errors/ class1) for T/C.	6	Accessories	: Thermo well and associated fittings	7	Standard	: IEC-584/ ANSI MC 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well
Sr. No.	Features	Essential/Minimum Requirements																									
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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 8 OF 34																								

CLAUSE NO.	TECHNICAL REQUIREMENTS			
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-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 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.			
3.05.00	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.		
3.05.00	TEMPERATURE TRANSMITTER (TT)			
	Following types of 2-wire (loop powered) temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.			
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 10 OF 34				

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	a. Single Input Head mounted Temperature Transmitter These shall be suitable for mounting in the head of temperature element itself. Temperature transmitter and associated temperature element shall be factory fitted. b. Single Input DIN-rail mounted Temperature Transmitter These shall be suitable for mounting on DIN-rails in JB's. The specifications of the JB's shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category. c. Dual-input Temperature Transmitter With integral Indicator: These shall be suitable for mounting on pipes/ support. Both elements of the duplex thermocouple/ RTD shall be wired to a single transmitter. Integral indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails .This change-over is to be alarmed. Protection class shall be IP65 minimum. d. Common requirements for each of the above type of temperature transmitters. Output : 2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal. Input : Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K & R types (input type to be selectable at site through HART terminal). Isolation : Min. 500 V AC. EMC compatibility : As per EN 61326. Operating ambient temperature : 0 to 85 deg C (without indicator). 0 to 70 deg C (with indicator). Power supply : 24V DC +/- 10%. Accessories : Mounting arrangements including clamps etc. Composite Accuracy (i) For head mounted and DIN-rail mounted types: (Refer note 2) RTD = <0.4% of 0-250 deg C span T/C-K type = <0.4% of 0-600 deg C span T/C-R type = <0.4% of 0-1000 deg C span CJC accuracy (for thermocouples) shall be = < 1 deg C (ii) For dual-input type: 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			
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 11 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS				
4.00.00	Notes (Common for a) to d) above):- 1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output. 2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A 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/ temp 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 are to be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input specified in (i) & (ii).				
	SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.				
	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	
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 12 OF 34

CLAUSE NO.	एनटीपीसी NTPC TECHNICAL REQUIREMENTS				
	7	Accuracy	±1% of span	± 1% of span	± 2%
	8	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
	9	Range selection	Shall cover 125% of max. operating press	Shall cover 125% of max. operating temp	Shall cover max. Operating level.
	10	Over range	125% of FSD	125% of FSD	-
	11	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
	12	Zero/span adjustment	Provided	Provided	--
	13	Identification	Engraved with service legend or laminated phenolic name plate		
	14	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.
	Notes:-				
	*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.				
	Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.				
	Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.				
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 13 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS 			
5.00.00	PROCESS ACTUATED SWITCHES			
	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
		Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application)	Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the application. .
	Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
	End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
	Over range/ proof pressure	150% of maximum operating pr.	-	150% of maximum operating pr.
	Repeatability	+/- 0.5% of full range		
	No. of contacts	2 No.+2NC. SPDT snap action dry contact		
	Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)		
	Elect. Connection	Plug in socket.		
	Set point adjustment	Provided over full range.		
	Dead band adjustment	Adjustable/ fixed as per requirement of application.		
	Enclosure	Weather and dust proof as per IP-55, metallic housing.		
	Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
	Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-
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 14 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.00.00	Power Supply (wherever required)	As per Contractor's Standard practice.	
	Notes :- 1) Where the process fluids are corrosive, viscous, solid bearing or slurry type diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. 2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications. 3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range. 4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.		
	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.		
8.00.00	SPECIFICATION FOR CORIOLIS FLOW TRANSMITTER		
	Type	Coriolis	
	Material of Wetted Parts	316 SS	
	Material of Housing	304L SS	
	Accuracy	± 0.2% of Rate	
	Repeatability	± 0.1% of Rate	
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 15 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS		
9.00.00 9.01.00	Output	4-20 mA DC, HART Compatible	
	Power Supply	230 VAC or 24VDC operated	
	Process Temperature range	0-200 degree Celsius	
	Others	Drain / purging arrangement shall be provided as per standard practice.	
	Viscosity range of Fluid	0-500cst for HFO	
	The offered Coriolis type flow transmitter shall be suitable for intended application. Contractor shall submit flow and sizing calculation for Employer's approval. For each type of Coriolis type flow transmitter general arrangement and assembly drawing and cable wiring diagram shall be submitted for Employer's approval.		
	SPECIFICATION FOR FLOW ELEMENTS		
	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 and6 mm for main pipe dia above300 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-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 16 OF 34			

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.02.00	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.			
	Flow Nozzle			
	Features	Essential/Minimum Requirements		
	Type	Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042		
	Material	316 SS		
	Thickness	Suitable for intended application.		
	Material of branch pipe	Same as main pipe		
	Root valve type	Globe		
	Root valve material	Same as pipe material		
	Root valve size	1 inch		
	Impulse pipe of same material up to root valve	Required		
	Tapping	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	Around 0.7		
	Beta Ratio calculation to be submitted	Yes		
	Assembly drg. and flow Vs DP Curves	Yes		
Accessories	Root valves, vent and drain hole.			
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
9.03.00	Venturi (For Liquid applications)			
	Features		Essential/Minimum Requirements	
	Type	Rough Welded (for Pipe dia between 200mm to 1200mm) or Machined (for Pipe dia 50mm to 250mm) as per ISO 5167-4:2003,		
	Material	Same as Main Pipe		
	Thickness	Same as Main Pipe.		
	Root valve type	Globe Type		
	Root valve material	Same as Pipe material		
	Root valve size	1 inch		
	Impulse pipe of same material up to root valve	Required		
	Tapping	3 pairs of tapings for each Venturi as per ISO 5167-4:2003, However for some areas like CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.		
	Beta Ratio	0.4 to 0.7		
	Beta Ratio calculation to be Submitted	Yes		
	Assembly drg. and flow Vs DP Curves	Yes		
Accessories	Root valves, vent and drain hole.			
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.				
9.04.00	ROTAMETERS			
	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	
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 18 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
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	± 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-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 19 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
10.01.00			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	
	Specific requirements for Hot-extractive sampling type SO2 analysers			
	Specification Requirements		SO2 Analyser cum monitor (combined)	
	Type of Instrument		Sampling type - Hot Extractive type	
	Principle of Measurement		Radiation absorption	
	Accuracy		+/- 1% of FS	
	Linearity		+/- 1% of FS	
	Repeatability		≤ 1% of Span	
	Response time(up to 90% of full scale)		≤ 5 secs	
	a) Temperature Drift		+/- 2% / 10 deg.C	
	b) Zero Drift		< 1% span/week	
	c) Span Drift		< 1% measured value/week	
Operating Temperature Range for probe		0-300 deg.C		
Filter		Ceramic 3.5 Micron		
Accessories for purging system		Purging system including Auto Scavenging facility shall be provided		
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			एनटीपीसी NTPC
10.02.00	Sample gas inlet temperature to analyser		Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards.	
	Specific requirements for Dilution Extractive type SOx Analysers			
	The design of the Dilution Extractive type system shall be satisfying the following requirements. The sampling system shall consist of In-situ dilution probe, dilution probe controller, sample conditioning system like air drier and filters etc and other accessories meeting the following requirements as a minimum. All system components and accessories required for completion of this system shall be furnished although these may not be individually specified herein. Following are the minimum requirements:			
	a) Modular Electronic Design.			
	b) Heatless Air dryer with inlet filter, chemical scrubbers to remove traces of NOx/CO2/SO2 from air and accumulator			
	c) Self test facility with screen display			
	d) Protection of instrument in case ambient or surrounding temp going high beyond stipulated limit			
	e) The following are the minimum requirement for the probe:- - Flange and counter flange for inserting probe - Coarse and Fine filters - Critical orifice - Automatic blow back or purging facility - SS316L probe material			
	f) Further dilution probe controller shall be provided with the ability to control dilution ratio			
	(g) Unheated umbilical chord to be provided for transportation of the diluted sample, zero air, vacuum pressure, and calibration gas. This chord has to be a single bundle in FRLS PVC outer sheath. The sample line has to be of PTFE.			
Specification Requirements		SO2 Analyser		
Principle of measurement		Pulsed/UV Fluorescence technology.		
Probe operating temp		0-300 deg C		
Zero drift		<1 ppb/day		
span drift		+/-1% FS/day		
Lower detection limit.		<=1.0 ppb		
Response time(up to 95% of full scale)		100 sec		
Accuracy/Precision.		+/- 1%		
Linearity		+/- 1% Full scale		
Sample gas inlet temperature to analyser		5 deg.C - 40 deg.C		
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 21 OF 34				

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
10.03.00	Specific requirements for In-situ (Path) type SO2 analysers		
	Specification Requirements	SO2 Analyser cum monitor	
	Principle of Measurement	Differential Optical Absorption Spectroscopy	
	Accuracy	<= 2% of measured value for SO2	
	Linearity	+/-1% of measurement span	
	Probe Operating Temperature Range	0 to 300 deg C	
	Accessories for purging system	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.	
	Temperature compensation	Automatic temperature compensation to be provided	
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
11.00.00	CONTINUOUS EMISSION MONITORING SYSTEM (CEMS):-		
	Continuous Emission Monitoring system consisting of the following equipments (Analysers/monitors) shall be provided for measurement of emissions in stack of each unit:- 1. SO2/NOx Analyser 2. CO analyser 3. CO2 analyser 4. Flue gas Flow Meter 5. Flue gas temperature measurement(As defined under Particulate Emission Analyser) 6. Particulate Emission (Stack Opacity) Analyser 7. Mercury Analyser The common requirements to be met for all types of analysers are as below. The specific requirements to be met by each type of analyser are detailed in the subsequent clauses.		
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

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
11.01.00	Common Requirements for all Analysers			
	1	Output signals		
		Analog	4-20 mA DC galvanically isolated.	
	2	Zero & span Adjustment	To be provided for all selectable ranges.	
	3	Ambient temp.	0-50°C unless defined otherwise.	
	4	Indication	Digital Alphanumeric Display. Display of reading in engineering units shall be provided.	
	5	Analyser enclosure Type/Material	Die cast Aluminium/SS. Weather protection for analyser mounted inside analyser panel shall be IP-22 or better. For all other analysers, weather protection class shall be IP-55.	
	6	Type of Electronics	Microprocessor based with self diagnostic.	
	7	Digital Signal transmission	RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol for bidirectional communication of stack emission data to Employer's cloud server	
	8	Calibration	Auto & Manual (from Remote)	
	9	Power Supply	To be arranged by Contractor subject to Employer's approval.	
	10.	Others	I) All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to DCS (in respective unit control room) are to be provided by Contractor.	
			ii) 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	Location of probe	SO2/NOx/CO/CO2-On stack at approximate elevation of 35 Mtrs. Particulate Emission (Stack Opacity) & Flow measurement -On stack at approximate elevation of 88 Mtrs Mercury:- on stack at 35 Mtrs.	
	12	Location of the analysers (other than insitu type)/Analyser Panel.	AT 0' Mtrs near stack for CEMS	
13	Compliance to standards	USEPA, TUV, MCERTS or equivalent standards		
14	Type of Technology	SO2/NOx :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Path) type		
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 23 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
11.02.00			CO :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Cross-duct) type. (can be combined with SO2/NOx) CO2 :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Cross-duct) type (can be combined with CO or SO2/NOx above). Stack Opacity :- In-situ (Path)type Note:- For Hot extractive sampling type and Dilution extractive sampling type system – The components involved in sample handling system shall be imported & further, Sample handling system design shall be vetted by Original Analyzer Manufacturer (OAM). Necessary documents shall be furnished during detailed engineering in order to establish the above requirement. Technical expert of OAM shall witness testing of sample handling system and validate it. Alternatively sampling handling system assembled at Original Analyzer manufacturer (OAM) works shall also be accepted.	
	15	Contractual conditions for CEMS system	Warranty:- As defined elsewhere in the Contract. Comprehensive Annual Maintenance Contract:- Refer sub-section-II-C-C& I/ Section-VI/ Part-A. This shall cover total maintenance of all hardware and software related to CEMS and shall include free repair/replacement of all components/cables/equipment etc and Supply of expendable items. Availability of valid data:-AT least 90% of time during warranty and CAMC period. For this purpose, contractor may take necessary steps to ensure availability. Services to be provided during Warranty and CAMC period shall be as per clause no. 2.04.00, 2.05.00 and 2.06.00, Sub-Section-III-C, SECTION-VI, PART-A	
	Specific requirements for Hot-extractive sampling type SO2/NOx, CO2 & CO analysers			
	Specification Requirements	SO2 Analyser and Nox Analyser cum monitor (combined)	CO2 ANALYZER	CO Analyser
	Type of Instrument	Sampling type - Hot Extractive type	Hot-Extractive	Hot-extractive type
	Principle of Measurement	Radiation absorption	NDIR absorption	NDIR absorption
	Measurement Range	0-300 ppm/ 0-1500 ppm (selectable)	0 to 40% (selectable)	0-200 ppm to 0-1000 ppm (selectable)
	Accuracy	+/- 1% of FS	+/-2% of measured value	+/- 2% of FS
	Linearity	+/- 1% of FS	+/- 1% of FS	+/- 1% of FS
	Repeatability	≤ 1% of Span	≤ 0.5% of Span	≤ 1% of Span
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 24 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC
11.03.00	Response time(up to 90% of full scale)	≤ 5 secs	≤ 5 secs	≤ 5 secs	
	a) Temperature Drift	+/- 2% / 10 deg.C	+/-1% in 24 hrs	+/- 2% / 10 deg.C	
	b) Zero Drift	< 1% span/week	< 1% span/week	< 2% span/week	
	c) Span Drift	< 1% measured value/week	< 1% measured value/week	< 1% measured value/week	
	Operating Temperature Range for probe	0-300 deg.C	0-300 deg.C	0-300 deg.C	
	Filter	Ceramic 3.5 Micron	Ceramic 3.5 Micron	Ceramic 3.5 Micron	
	Accessories for purging system	Purging system including Auto Scavenging facility shall be provided	Purging system including Auto Scavenging facilityshall be provided	Purging system including Auto Scavenging facility shall be provided	
	Sample gas inlet temperature to analyser	Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards.	Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards.	Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards.	
	Specific requirements for Dilution Extractive type SOx/NOx/CO2 & CO Analysers				
	The design of the Dilution Extractive type system shall be satisfying the following requirements. The sampling system shall consist of In-situ dilution probe, dilution probe controller, sample conditioning system like air drier and filters etc and other accessories meeting the following requirements as a minimum. All system components and accessories required for completion of this system shall be furnished although these may not be individually specified herein. Following are the minimum requirements:				
a) Modular Electronic Design. b) Heatless Air dryer with inlet filter, chemical scrubbers to remove traces of NOx/CO2/SO2 from air and accumulator c) Self test facility with screen display d) Protection of instrument in case ambient or surrounding temp going high beyond stipulated limit e) The following are the minimum requirement for the probe:- Flange and counter flange for inserting probe					
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 25 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS				एनटीपीसी NTPC																																																						
	- Coarse and Fine filters - Critical orifice - Automatic blow back or purging facility - SS316L probe material																																																										
	f) Further dilution probe controller shall be provided with the ability to control dilution ratio																																																										
	g) Unheated umbilical chord to be provided for transportation of the diluted sample, zero air, vacuum pressure, and calibration gas. This chord has to be a single bundle in FRLS PVC outer sheath. The sample line has to be of PTFE.																																																										
<table><tr><th>Specification Requirements</th><th>SO2 Analysyer</th><th>NOx Analysyer</th><th>CO2 Analysyer</th><th>CO Analysyer</th></tr><tr><td>Principle of measurement</td><td>Pulsed/UV Fluorescence technology.</td><td>Chemiluminescence technology.</td><td>Gas Filter correlation</td><td>Gas Filter Correlation technology</td></tr><tr><td>Measurement Range</td><td>0-1500 ppm (selectable)</td><td>0-500 ppm (selectable)</td><td>0 to 40% (selectable)</td><td>0-200 ppm to 0-1000 ppm (selectable)</td></tr><tr><td>Probe operating temp</td><td>0-300 deg C</td><td>0-300 deg C</td><td>0-300 deg C</td><td>0-300 deg.C</td></tr><tr><td>Zero drift</td><td><1 ppb/day</td><td>< 0.5 ppb/day</td><td><=1 ppm/day</td><td><0.1 ppm/day</td></tr><tr><td>span drift</td><td>+/-1% FS/day</td><td>+/-1% FS/ day</td><td>+/-2% FS/day</td><td>+/-1%FS/day</td></tr><tr><td>Lower detection limit.</td><td><=1.0 ppb</td><td><=0.4 ppb</td><td><=1 ppm</td><td>0.05 ppm</td></tr><tr><td>Response time(up to 95% of full scale)</td><td>100 sec</td><td>60 sec</td><td>90 sec</td><td>60 sec</td></tr><tr><td>Accuracy/Precision.</td><td>+/- 1%</td><td>+/- 1%</td><td>+/- 1%</td><td>+/- 1%</td></tr><tr><td>Linearity</td><td>+/- 1% Full scale</td><td>+/- 1% Full scale</td><td>+/- 1.5% Full scale</td><td>+/- 1% of Full scale</td></tr><tr><td>Sample gas inlet temperature to analyser</td><td>5 deg.C - 40 deg.C</td><td>5 deg.C - 40 deg.C</td><td>5 deg.C - 40 deg.C</td><td>5 deg.- 40 deg.C</td></tr></table>					Specification Requirements	SO2 Analysyer	NOx Analysyer	CO2 Analysyer	CO Analysyer	Principle of measurement	Pulsed/UV Fluorescence technology.	Chemiluminescence technology.	Gas Filter correlation	Gas Filter Correlation technology	Measurement Range	0-1500 ppm (selectable)	0-500 ppm (selectable)	0 to 40% (selectable)	0-200 ppm to 0-1000 ppm (selectable)	Probe operating temp	0-300 deg C	0-300 deg C	0-300 deg C	0-300 deg.C	Zero drift	<1 ppb/day	< 0.5 ppb/day	<=1 ppm/day	<0.1 ppm/day	span drift	+/-1% FS/day	+/-1% FS/ day	+/-2% FS/day	+/-1%FS/day	Lower detection limit.	<=1.0 ppb	<=0.4 ppb	<=1 ppm	0.05 ppm	Response time(up to 95% of full scale)	100 sec	60 sec	90 sec	60 sec	Accuracy/Precision.	+/- 1%	+/- 1%	+/- 1%	+/- 1%	Linearity	+/- 1% Full scale	+/- 1% Full scale	+/- 1.5% Full scale	+/- 1% of Full scale	Sample gas inlet temperature to analyser	5 deg.C - 40 deg.C	5 deg.C - 40 deg.C	5 deg.C - 40 deg.C	5 deg.- 40 deg.C
Specification Requirements	SO2 Analysyer	NOx Analysyer	CO2 Analysyer	CO Analysyer																																																							
Principle of measurement	Pulsed/UV Fluorescence technology.	Chemiluminescence technology.	Gas Filter correlation	Gas Filter Correlation technology																																																							
Measurement Range	0-1500 ppm (selectable)	0-500 ppm (selectable)	0 to 40% (selectable)	0-200 ppm to 0-1000 ppm (selectable)																																																							
Probe operating temp	0-300 deg C	0-300 deg C	0-300 deg C	0-300 deg.C																																																							
Zero drift	<1 ppb/day	< 0.5 ppb/day	<=1 ppm/day	<0.1 ppm/day																																																							
span drift	+/-1% FS/day	+/-1% FS/ day	+/-2% FS/day	+/-1%FS/day																																																							
Lower detection limit.	<=1.0 ppb	<=0.4 ppb	<=1 ppm	0.05 ppm																																																							
Response time(up to 95% of full scale)	100 sec	60 sec	90 sec	60 sec																																																							
Accuracy/Precision.	+/- 1%	+/- 1%	+/- 1%	+/- 1%																																																							
Linearity	+/- 1% Full scale	+/- 1% Full scale	+/- 1.5% Full scale	+/- 1% of Full scale																																																							
Sample gas inlet temperature to analyser	5 deg.C - 40 deg.C	5 deg.C - 40 deg.C	5 deg.C - 40 deg.C	5 deg.- 40 deg.C																																																							

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 26 OF 34
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CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC			
11.04.00	Specific requirements for In-situ (Path) type SO₂/NO_x, CO₂ & CO analysers			
	Specification Requirements	CO Analyser cum monitor	SO₂/NO_x Analyser cum monitor	CO₂ Analyser cum monitor
	Principle of Measurement	IR absorption	Differential Optical Absorption Spectroscopy	Differential Optical Absorption Spectroscopy
	Measurement Range	0-200, 0-1000 ppm, (selectable)	0-300 ppm/ 0-1500 ppm (selectable)	0-40% (selectable)
	Accuracy	+/- 5% of FS	<= 2% of measured value for SO ₂ and +/- 5% for NO ₂	
	Linearity	+/-2% of FS	+/-1% of measurement span	+/-1% of measurement span
	Repeatability	≤ 0.5% of Span		
	Response time(up to 90% of full scale)	≤ 5 sec		
	a) Temperature Drift	Automatic temp compensation		
	b) Zero Drift	<1% span/week		
	c) Span Drift	< 1% measured value / week		
	Probe Operating Temperature Range	0 to 300 deg C	0 to 300 deg C	0 to 300 deg C
	Accessories for purging system	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.
	Temperature compensation	Automatic temperature compensation to be provided	Automatic temperature compensation to be provided	Automatic temperature compensation to be provided
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 27 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS				
11.05.00	Specific requirements for Particulate Emission (Dust density Stack Opacity) monitor				
	Specification Requirements		PARTICULATE EMISSION (Dust density Stack Opacity) monitor		
	Type of Instrument *		In-Situ dry type visible light (through LED) stack		
	Principle of Measurement		Transmission and absorption		
	Measurement Range		0 to 999mg/m2, (Programmable)		
	Accuracy		2% of FS		
	Linearity		+/- 1% of FS		
	Repeatability		≤ 1% of Span		
	Response time(up to 90% of full scale)		≤ 5 sec		
	a) Temperature Drift		+/-1% in 24 hrs		
	b) Zero Drift		< 1% span/week		
	c) Span Drift		< 1% measured value/week		
	Operating Temperature Range for probe		0-300 deg.C		
	Filter		To be provided		
	Accessories purging system		Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.		
	Temperature compensation/measurement		Temperature compensation to be provided. Further, additional 4-20 mA signal for stack temperature through temperature transmitter shall be provided and connected to DDCMIS.		
	11.06.00	Note: * For stack dust density measurement - In case specified type of instrument is not suitable for the actual flue gas parameters at chimney, the contractor can provide suitable instrument based on other proven technology for the intended application & meeting the other technical requirements specified above, subject to Employer's approval during detailed engineering. Contractor shall furnish necessary documents in support of suitability and provenness of instruments for envisaged application.			
Specific requirements for Continuous On-line Mercury Analyser					
S.NO.		PARAMETER	DETAILS		
1		Measurement Principle	Atomic Absorption Spectrometry/ Atomic Fluorescence spectrometry.		
	2	Range	0-100 microgram/Nm3		
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 28 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS		
11.07.00	ULTRASONIC FLOW METER FOR FLUE GAS FLOW IN STACK		
	Type	Transit time Ultrasonic meter	
	Mounting Style	Transducers on the duct/stack	
	Transducer type and material	Single pair of Corrosion resistant material to be provided	
	Zero and Span adjustment	To be provided	
	Flow measurement	Instantaneous Flow rate as well as totalized flow	
	Power supply Distribution	to be arranged by the Contractor from Employer's terminal point.	
	Outputs : Analog Datalink	4-20 mA DC galvanically isolated. RS 232/RS485/Modbus protocol/ Ethernet TCP/IP protocol for bidirectional communication link with Employer's cloud server	
	Display/Indication	Flow meter with LCD screen backlight based local display and keypad . If required, transmitter shall be suitably located away from the sensor for better access and visibility.	
	Recording / Totalizing/Logging Facilities	To be provided	
	Diagnostics	False signal tolerance , power supply failure etc	
	Protection class	IP-65 or better	
	Ambient temperature	-20 deg to +60 deg C	
	Accuracy	<+/- 2%	
	Electrical connection	Plug and socket	
	Accessories	All mounting hardware required like clamping fixtures, mechanism to remove the transducers online, interconnecting cables to DDCMIS, cables, flexible conduits, junction boxes etc Purging arrangement for Cleaning sensors to be provided. Material of all fittings shall be SS 316.	
Software features	Compensation for temperature and pressure and any cross path errors. Programming, configuration, shall be possible from front panel.		
NOTES:-			
01. Hot extractive sampling type/ Dilution extractive type systems shall be provided with dual sample probes along with all required accessories such as redundant			
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 29 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS			
11.08.00	heavy duty pumps with continuous rated motors, moisture detection facility, pre-fabricated heated (for sampling type only) sample lines from probes to analyser panel, solenoid valves, filters, coolers along with level switch in gas coolers for auto draining purpose and flow meter etc as applicable.			
	02. Not used			
	03. If the SOx, NOx, CO2 & CO (if sampling/dilution type) analyzers do not meet the environmental conditions specified at cl. 4.00.00 of Sub Sec IIIC-01, Section-VI, Part-B, panel AC shall be provided in analyzer cabinets to meet the requirement.			
	04. Not used			
11.08.00	Connectivity with DDCMIS and provision for bidirectional communication with Employer's Cloud Server			
12.00.00	1. 4-20mA signals from all the above analysers/flow meters/temperature transmitter to DCS of respective unit.			
	2. RS232/ RS485 Modbus protocol/ Ethernet TCIP/IP protocol for bidirectional communication with Employer's Cloud Server as defined in Sub-section-IIC-C&I/ Section-VI/ Part-A.			
	All the accessories and cables required for connecting Analysers outputs to DCS and provision of bidirectional communication as defined above shall be provided by Contractor on as required basis.			
	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		
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 30 OF 34				

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
		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.		
12.02.00	Conductivity Analyser			
	1. Type	Continuous flow through type		
	2. Range	- As per the process requirement, Freely programmable 0-2500 ppm for Total Dissolved Solids (TDS).		
	3. Accuracy	<=+/- 1 % of reading		
	4. Temperature Compensation	Automatic		
	5. Response time	<=5Sec		
	6. No. of Streams	Single		
	7. Other	Wherever cation conductivity measurement have been specified dual cation exchange column shall be provided.		
	12.03.00	pH analyser		
	1. Type	Continuous flow through type		
	2. Range	0 - 14 pH freely programmable		
	3. Accuracy	< ± 1% of reading		
	4. Temperature Compensation	Automatic		
5. No. of Streams	Single			
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 31 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS			
12.04.00	Turbidity Analyser			
	1. Type	Light reflection principle		
	2. Range	0-100, 0-200 NTU programmable		
	3. Accuracy	<= 2% for range 0 – 50 NTU <= 5% for range 50 - 200 NTU		
	4. Response time (90 % of full scale)	<= 5 minutes.		
	5. No. of Streams	Single		
12.05.00	Phosphate Analyser			
	1. Type	Colorimetric		
	2. Range	0-10 ppm freely programmable		
	3. Accuracy	<= +/- 5 % of reading		
	4. Temperature Compensation	Automatic, however, If the measurement technique is temperature insensitive within the range or if the temperature is closely maintained at a set value, the same are also acceptable.		
	5. Response time	<= 15 min		
12.06.00	Chloride Analyser			
	1. Type	Continuous Flow through type with chloride and sulphate Responsive electrodes		
	2. Range	0-1000 ppb freely programmable		
	3. Accuracy	<= +/- 5 % of reading		
	4. Temperature Compensation	Automatic		
	5. No. of Streams	Single		
12.07.00	Silica Analyser			
	1. Type	Continuous Colorimetric Type		
	2. Range	0-50, 0-100, 0-500 ppb freely programmable		
	3. Accuracy	<= +/- 5 % of reading		
	4. Temperature Compensation	Automatic, however, If the measurement technique is temperature insensitive within the range or if the temperature is closely maintained at a set value, the same are also acceptable.		
	5. Response time	<= 15 min		
	6. No. of Streams	Multi Stream with at least one stream as spare.		
	7. Sample Flow	50-150 ml/min		
12.08.00	Sodium Analyser			
	1. Type	Continuous Flow Through Sample		
	2. Range	0-1, 0-10, 0-200, 0-2000 ppb freely programmable		
	3. Accuracy	<= +/- 10 % of reading		
	4. Temperature Compensation	Automatic		
	5. Response time	<= 4 min		
	6. No. of Streams	Multi Stream with at least one stream as spare.		
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 32 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
12.09.00	7. Sample Flow	125 ml/min (max)	
	Hydrazine Analyser		
	1. Type	Automatic Continuous Electrochemical Type	
	2. Range	0-50, 0-100, 0-500 ppb freely programmable	
	3. Accuracy	<= +/- 5 % of full scale	
	4. Temperature Compensation	Automatic	
	5. Response time	<= 3 min	
	6. No. of Streams	Single	
	7. Sample Flow	500 ml/min (max)	
12.10.00	8. Other requirement	Sample shut off solenoid valve to be provided	
	Dissolved O2 Analyser		
	1. Type	Continuous Flow Through Sample	
	2. Range	0-20, 0-200 ppb freely programmable	
	3. Accuracy	<= +/- 5 % of full scale	
	4. Temperature Compensation	Automatic	
	5. Response time	<= 30 sec	
	6. No. of Streams	One single stream, one switchable between two.	
12.11.00	7. Sample Flow	500 ml/min (max)	
	Residual Chlorine Analyser		
	The analyser shall comply with the following specification requirements, as a Minimum		
	1. Type	Amperometric type	
	2. Range	0 to 20.0 mg/L (ppm)	
	3. Accuracy	<= +/- 5 % (see Note – 1)	
	4. Alarm annunciation	High and low alarms to be provided on panel and shall be field adjustable.	
	5. Calibration	Zero and span adjustment facility to be provided. Final calibration adjustments of the analyser to be done at site and duly verified by titration. Temperature compensation range 0 to 50 deg.C.	
	6. Connections	All connections for sampling drain etc. to be provided.	
	7. Cabling	All field cabling power cables and panel wiring etc., to be provided.	
	8. Electrodes	Platinum/Gold and copper electrodes shall be provided with cell cleaning system.	
	Note-1: The measurement accuracy shall not be affected by presence of treatment chemicals as chromates, phosphates, de-former highly polluted water, change in temperature etc.		
Note-2: Circulating water as sample to residual chlorine analyser shall be taken from hot circulating water pipe work before entry to cooling towers. Exact location and layout of sampling arrangement shall be finalized during detailed Engg. stage. Bidder shall provide necessary pumping system (with 100% standby) for meeting the analyser requirements, if needed. All the drains shall be terminated up to the nearest Employer's plant drainage system.			
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 33 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC																
13.00.00	Parshall Flume Parshall Flume shall be provided wherever indicated in P&IDS. The Bidder shall provide all the control and Instrument devices including primary sensors, transmitters, flow indicator cum integrator / totaliser and shall include all required accessories for the flow measurement of raw water through the clarifier. The system shall be of reputed make and acceptable to the owner. Level measurement shall be based on ultrasonic/radan technology. The flow compensation is to be implemented in the transmitter itself. The transmitter shall provide 4-20 mA DC in direct proportion to flow and shall be able to drive a load impedance of 500 ohms minimum. Accuracy shall be +/- 1 % or better. All the mounting hardware and accessories required for erection and commissioning of the same are to be provided by the contractor. Mounting fittings material shall be SS316. All weather canopy is to be provided for electronics/sensor to protect the same from The Type makes and models no. shall be subject to Owner's approval.																			
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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(f) Protection class :	IP-55																			
(g) Flow tube	SS304																			
(h) liner	Hard Rubber																			
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 34 OF 34																

SUB-SECTION-III-C3

PROCESS CONNECTION AND PIPING

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								
	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 ½” for Steam & Water Application and ¾” 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: <table><tr><td>Impulse Pipes, Tubes (Material, Rating)</td><td>ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70</td></tr><tr><td>Valves (Material, Pr. Class, Size)</td><td>ASTM A182/ASTM A105 as per ASME 16.34</td></tr><tr><td>Fittings (Size, Rating, Material)</td><td>ANSI B31.1, ANSI B31.1a, ASME B16.11-2009</td></tr><tr><td>Installation Schemes</td><td>BS 6739-2009, ANSI/ISA 77.70</td></tr></table> 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/cm² 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.				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
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											
1.01.03	The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below: <table><tr><th>Manifold</th><th>Application/Measurement</th></tr><tr><td>2 Valve</td><td>Pressure measurements using pressure transmitters/pressure switches</td></tr><tr><td>3 Valve</td><td>Pressure measurements using differential pressure transmitter/ switches</td></tr><tr><td>5 Valve</td><td>Differential Pressure, Flow and Level Measurements</td></tr></table> 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 .				Manifold	Application/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
Manifold	Application/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											
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	एनटीपीसी NTPC	
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

SUB-SECTION-III-C4

INSTRUMENTATION CABLES

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														
1.00.00	INSTRUMENTATION CABLE, CONTROL & POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL (CABLE SUB-TRAYS ETC)														
1.01.00	General requirements														
1.01.01	All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.														
1.01.02	The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope and ensuring completeness of the control system.														
1.01.03	Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.														
1.01.04	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														
	<table><tr><th>S. No.</th><th>Property</th><th>Requirement</th></tr><tr><td>1</td><td>Operating Voltage</td><td>225 V (peak value)</td></tr><tr><td>2.</td><td>Codes and standard</td><td>All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.</td></tr><tr><td>3.</td><td>Continuous operation suitability</td><td>At 205 Deg C for Type-C cables & heat resistant cables, at 70 Deg C for all other type of cables.</td></tr></table>	S. No.	Property	Requirement	1	Operating Voltage	225 V (peak value)	2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.	3.	Continuous operation suitability	At 205 Deg C for Type-C cables & heat resistant cables, at 70 Deg C for all other type of cables.		
S. No.	Property	Requirement													
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					एनटीपीसी NTPC
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable	
	Overall cable assembly shielding	To be provided				
	Minimum thickness of Overall cable assembly shielding	0.055 mm (55 micron)				
	Coverage / Overlapping	100% / 20%				
	Drain wire provided for individual shield	N.A.	Yes (for F-type) Size- 0.5 sqmm No of strands-7 Dia of strands- 0.3mm Annealed Tin coated copper	N.A.		
	Drain wire provided for overall shield	Yes, Size- 0.5 sqmm,No of strands-7,Dia of strands- 0.3mm,Annealed Tin coated copper				
	E. FILLERS (if applicable)					
	Non-hygroscopic, flame retardant	To be provided				
	F. OUTER SHEATH					
	Material	Extruded PVC compound YM1 with FRLS properties			Teflon (i.e. extruded FRP)	
	Minimum Thickness at any point	1.8 mm			0.4 mm	
	Nominal Thickness at any point	>1.8 mm			0.5 mm	
	Resistant to water, fungus, termite & rodent attack	Required				
	Minimum Oxygen index as per ASTMD-2863	29 %			N.A.	
	Minimum Temperature index as per ASTMD-2863	250 deg.C			N.A.	
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%		N.A.
		(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)		
	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 PAGE 5 OF 13

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					
3.00.00	SPECIFICATION OF OPTICAL FIBER CABLES (OFC)					
3.01.00	Optic Fiber cable shall be 4/8/12 core, Electrolytically chrome plated corrugated steel taped (ECCST), fully water blocked with dielectric central member for outdoor/indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multi mode fibers on as required basis so as to avoid the usage of any repeaters. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturer, progressive automatic sequential on-line marking of length in meters at every meter.					
3.02.00	The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Dielectric central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum& crush resistance 4000 N minimum. The operating temperature shall be – 20 deg. C to 70 deg.C					
3.03.00	All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards.					
3.04.00	Bidder to ensure that minimum 100% cores are kept as spares in all types of optical fibre cables.					
3.05.00	Cables shall be suitable for laying in conduits, ducts, trenches, racks and under ground buried installation.					
3.06.00	Spliced / Repaired cables are not acceptable.					
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																																																					
<table><tr><th colspan="2">Application</th><th colspan="2">Type Of Termination</th><th rowspan="2">Type Of Cable</th></tr><tr><th>FROM (A)</th><th>TO (B)</th><th>END A</th><th>END B</th></tr><tr><td>Valves/dampers drives (Integral Junction box)</td><td>Marshalling / Marshalling – cum Termination Cubicle / local group JB</td><td>Plug in connector</td><td>Post mount cage clamp type.</td><td>G</td></tr><tr><td>Transmitters, Process Actuated switches mounted in LIE/LIR</td><td>Integral Junction box of LIE/LIR</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr><tr><td>RTD heads</td><td>Local junction box</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F</td></tr><tr><td>Thermocouple</td><td>Local junction box / CJC box (if applicable)</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>A, B, C*</td></tr><tr><td>Other Field mounted Instrument</td><td>Local JB / Group JB</td><td>Plug in connector</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr><tr><td>RTD</td><td>Temperature transmitter</td><td>Plug in connector</td><td>Screwed, Cage clamp type</td><td>F</td></tr><tr><td>Thermocouple</td><td>Temperature transmitter</td><td>Plug in connector</td><td>Screwed, Cage clamp type</td><td>A, B, C*</td></tr><tr><td>Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ MCC/SWGR</td><td>Group JB</td><td>Cage clamp (Rail mount) type.</td><td>Cage clamp (Rail mount) type.</td><td>F,G</td></tr></table>						Application		Type Of Termination		Type Of Cable	FROM (A)	TO (B)	END A	END B	Valves/dampers drives (Integral Junction box)	Marshalling / Marshalling – cum Termination Cubicle / local group JB	Plug in connector	Post mount cage clamp type.	G	Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G	RTD heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F	Thermocouple	Local junction box / CJC box (if applicable)	Plug in connector	Cage clamp (Rail mount) type.	A, B, C*	Other Field mounted Instrument	Local JB / Group JB	Plug in connector	Cage clamp (Rail mount) type.	F,G	RTD	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	F	Thermocouple	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	A, B, C*	Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ MCC/SWGR	Group JB	Cage clamp (Rail mount) type.	Cage clamp (Rail mount) type.	F,G
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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				एनटीपीसी NTPC
6.00.00 6.01.00	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								
	mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval.								
6.02.00	All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, transparent covers, support brackets, distance sleeves, warning label, marking, etc.								
6.03.00	The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.								
6.04.00	For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065.								
6.05.00	The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.								
7.00.00	INTERNAL PANELS/ SYSTEM CABINETS WIRING								
7.01.00	Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.								
7.02.00	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.								
7.03.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.								
7.04.00	All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.								
7.05.00	All the special tools as may be required for solder less connections shall be provided by Bidder.								
7.06.00	Wire sizes to be utilised for internal wiring. <table><tr><td>(i)</td><td>Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system.</td><td>0.5 Sq.mm.</td></tr><tr><td>(ii)</td><td>Power supply and internal illumination.</td><td>2.5Sq.mm. minimum (shall be as per load requirement.)</td></tr></table>			(i)	Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system.	0.5 Sq.mm.	(ii)	Power supply and internal illumination.	2.5Sq.mm. minimum (shall be as per load requirement.)
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(ii)	Power supply and internal illumination.	2.5Sq.mm. minimum (shall be as per load requirement.)							
8.00.00	INSTRUMENTATION CABLE INSTALLATION AND ROUTING								
8.01.00	All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.								
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		एनटीपीसी NTPC									
8.02.00	Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows: <table><tr><td>From 11 kV/6.6 kV/3.3 kV tray system</td><td>-</td><td>914 mm</td></tr><tr><td>From 415V tray system</td><td>-</td><td>610 mm</td></tr><tr><td>From control cable tray system</td><td>-</td><td>305 mm</td></tr></table>			From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm	From 415V tray system	-	610 mm	From control cable tray system	-	305 mm
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 burried trench approx.1.0 meter depth, to be laid in 2” rodent proof HDPE conduits covered with sand, brick, laid breadth-wise and soil along the pipe line route by contractor; While crossing roads - to be laid in GI/ rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete; While crossing canals/river- to be laid in rodent proof HDPE conduits within hume pipe. 10 Laying of Network Cable (UTP/STP) : Out side Building Area- to be laid necessarily inside GI conduits with support from cable tray / Trestle structure. Inside Building Area- to be laid necessarily inside GI conduits on separate cable sub-trays.	
9.02.00	Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.	
9.03.00	Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.	
9.04.00	The Bidder shall be responsible for proper grounding of all equipment under this package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests.	
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	एन टी पी सी 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			
	(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spares terminals.	
	(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester (FRP).	
	(iii)	Type	Screwed at all four corners for door. Door gasket shall be of synthetic rubber.	
	(iv)	Mounting clamps and accessories	Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply.	
	(v)	Type of terminal blocks	Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm ² . A M6 earthing stud shall be provided.	
	(vi)	Protection Class	IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.	
	(vii)	Grounding	To be provided.	
	(viii)	Color	RAL 7035	
11.00.00	CONDUITS			
11.01.00	Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant terne coated steel with , water leak, fire and rust proof protected <i>for the areas of Mills,Drum, Main Steam, RH steam Air Heaters and Furnace, BFPDT's</i> . <i>And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided.</i> The temperature rating of flexible conduit shall be suitable for actual application.			
11.02.00	All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.			
11.03.00	Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform with NEC requirements for the area classification.			
11.04.00	Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be			
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 		
11.05.00 12.00.00 12.01.00 12.02.00	utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits. Conduits shall be securely fastened to all boxes and cabinets. CABLE SUB-TRAY & SUPPORT The cable sub-trays and the supporting system, to be generally used between Local/Group JBs and the main cable trays and the same shall be furnished and installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route). 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

SUB-SECTION-III-C5

PLC BASED CONTROL SYSTEM

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			
	PLC BASED CONTROL SYSTEM			
1.00.00	CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY PACKAGES			
1.01.00	Contractor shall provide complete Control and Instrumentation system with all accessories, auxiliaries and associated equipments and cables for the safe, efficient and reliable operation of the plant auxiliary systems as indicated under scope part at III C, Part-A, Section VI.			
1.02.00	The quantity of instruments for each plant 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 instruments and devices, which are needed for the completeness of the plant auxiliary system/equipment, supplied by the Contractor, even if the same is not specifically appearing in the P&ID.			
1.03.00	All instruments and control equipments like primary and secondary instruments etc. shall meet the requirements specified in Sub-Section - MEAS INST, Part-B, Section VI. In addition, all electrical instrument devices like switches/ transmitters/ controllers/analyzers/solenoid valves which are located in the field/hazardous locations shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I. All fittings, cable glands etc. shall be strictly as per NEC recommendation article, 500 to 503.			
1.04.00	Contractor shall provide independent control systems for safe, efficient and reliable operation of each of the plant auxiliary systems. The type of control system shall be as indicated under scope part at III C, Part-A, Section VI.			
1.05.00	ON/OFF control, indication, annunciation of incomers and bus-coupler (even if they are not in the scope of the contractor) are also to be performed from Contractor's Control System for each of the plant auxiliary system as applicable.			
1.06.00	It shall be possible to remove/replace online various modules (like any I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected (including controller trip to manual, etc) except that information related to removed module is not available to controller. Further, it shall also be possible to remove/replace any of the redundant controller module without switching off the power to the corresponding rack and this will not result in system disturbance or loss of any controller functions for the other controller. The on-line			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 1 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS 
1.07.00	removal/insertion of controller, I/O modules shall in no way jeopardize safety of plant and personnel. The control system shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is jeopardized. Control system shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuit/short circuit, instrument air supply failure etc. On any of these failures the controlled equipment/parameter shall either remain in last position before failure or shall come to fully open/close or on/off state as required for the safety of plant/personnel/equipment and as finalised during detailed engineering. System shall be designed such that there will be no upset when Power is restored.
1.08.00	The Control system shall include on-line self-surveillance, monitoring and diagnostic facility giving the details of the fault on the Human Machine Interface System (HMIS). The faults to be reported shall include fault in main & standby power supplies, sensor fault, Input/ Output card failure, Memory Status, Controller fault, failure of Communication/ Network links to PLCs, LAN etc. These faults shall be reported as color change on system status display and as messages on HMIS as well as through local indication on the faulty module and on respective rack/ cubicle. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place.
1.09.00	The Control system shall be located in Air conditioned area. However the referred control system shall be designed to operate in non-air conditioned area also and shall meet the minimum requirements as specified below.
1.10.00	Also refer configuration diagram for PLC based off-site control system, drawing no. 0000-151-POI-A-013.
2.00.00	PROGRAMMABLE LOGIC BASED CONTROL SYSTEM
2.01.00	PLC PROCESSOR The processor unit shall be capable of executing the following functions:- - a Receiving binary and analog signals from the field and providing command output to MCC/SWGR/Drive etc. through Input / Output modules and operator initiated commands from HMIS / control panel. - b Implementing all logic functions for control, protection and annunciation of the equipment and systems.
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-C5 PLC BASED CONTROL SYSTEM PAGE 2 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	c Implementing modulating control function for certain application as specified elsewhere in the specification. d Providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc. e Performing self-monitoring and diagnostic functions.			
2.02.00	Wherever Dual processor based PLC system has been specified, each PLC unit shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete plant operation automatically. The transfer from main processor to standby processor shall be totally bump less and shall not cause any plant disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor. Wherever multiple functional groups have been specified/ required, the above requirements are applicable for each functional group.			
2.03.00	The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation and have a capability for at least 20% expansion in future. Programmed operating sequences and criteria shall be stored in non volatile semi conductor memories like EPROM. All dynamic memories shall be provided with buffer battery back up which shall be for at least 360 hours. The batteries shall be lithium or Ni-Cd type.			
2.04.00	Priority of different commands shall be as follows:			
2.04.01	Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.			
2.04.02	A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program.			
2.05.00	HUMAN MACHINE INTERFACE SYSTEM (HMIS)			
2.05.01	Operator work station (OWS) shall perform control, monitoring and operation of all auxiliaries/ drives interacting with PLC based control system. It shall be possible to use the same as programming station of the PLC and the Human Machine Interface			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 3 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	System. It shall basically perform the following functions. In case the PC based OWS can not be used as programming station of the PLC and the Human Machine Interface System, then separate PC based programming station shall be provided. 2.05.02 Operator shall be able to access all control/information related data under all operating conditions including a single processor/computer failure in the HMIS. 2.05.03 All frequently called important functions including major displays shall be assigned to dedicated function keys on a soft keyboard for the convenience of the operator for quick access to displays & other operator functions. 2.05.04 The operator functions for each OWS shall as a minimum include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local-remote/other multi-position selection etc.); alarm acknowledge; call all kind of displays, logs, summaries, calculation results, etc.; printing of logs & reports; retrieval of historical data; and any other functions required for smooth operation, control & management of information as finalized during detailed engineering. 2.05.05 The display selection process shall be optimized so that the desired display can be selected with the minimum no. of operations. Navigation from one display to any other should be possible efficiently through paging soft keys as well as through targets defined on the displays. There should be no limitation on number of such targets. 2.05.06 The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorized use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights as finalised by the Employer during detailed engineering. However, no. of user levels, no. of users in a level and rights for each level shall be changeable by the programmer (Administrator). When any drive or sequence is being controlled from one OWS, the system shall inhibit control access of the same drive or sequence from other OWS or Local Control Panel.			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 4 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.06.00	PROGRAMMING FUNCTIONALITIES Programming of the PLC Processor / controller as well as programming of HMIS shall be user friendly with graphical user interface and shall not require knowledge of any specialized language. For example, the programming of PLC shall use either of the following:- - Flow-chart or block logic representing the instructions graphically. - Ladder diagrams. The programming of HMIS (like development and modification of data base, mimics, logs / reports, HSR functionalities etc.) shall also be possible through user-friendly menus etc All programming functionalities shall be password protected to avoid unauthorised modification.			
2.07.00	SOFTWARE REQUIREMENT			
2.07.01	All necessary software required for implementation of control logic, operator station displays / logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. The contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.			
2.07.02	The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification.			
2.07.03	Industry standard operating system like UNIX/WINDOWS (latest version) etc. to ensure openness and connectivity with other system in industry standard protocols (TCP-IP/ OPC etc.) shall be provided. The system shall have user friendly programming language & graphic user interface.			
2.07.04	All system related software including Real Time Operating System, File management software, screen editor, database management software. On line diagnostics/debug software, peripheral drivers software and latest versions of standard PC-based software and latest WINDOWS based packages etc. and any other standard language offered shall be furnished as a minimum.			
2.07.05	All application software for PLC system functioning like input scanning, acquisition, conditioning processing, control and communication and software for operator			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 5 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.07.06	interface of monitors, displays, trends, curves, bar charts etc. Historical storage and retrieval utility, and alarm functions shall be provided.			
	The Contractor shall provide software locks and passwords to Employer’s engineers at site for all operating & application software so that Employer’s engineers can take backup of these software and are able to do modifications at site.			
2.08.00	PARAMETRIC REQUIREMENTS			
	The control system shall be designed such that under worst case loading conditions the response time shall not be worst than the following:-			
	On/Off Command	-	The response time for screen update after the execution of the control command from the time the command is issued (for example command to start a motor to the time the screen is updated) shall be two seconds (excluding the drive actuation time).	
	Adjustment Command	-	0.5 to 1 second.	
	On screen Updating	-	1 second.	
	All Control related displays	-	1 second.	
	Bar Chart displays	-	2 to 3 seconds.	
	Plant Mimic displays	-	2 to 3 seconds.	
	Group review displays	-	2 to 3 seconds.	
	X-T Plot Displays	-	1 to 2 seconds.	
	Plant Summary Displays	-	1 to 2 seconds.	
	Even under worst case loading condition of HMIS and system Bus, each HMIS processor shall have 50 % spare time when measured over any one minute period and the system bus shall have at least 50 % spare duty cycle.			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 6 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.00.00	INPUT/OUTPUT MODULES		
3.00.01	The PLC system should be designed according to the location of the input/output cabinets as specified.		
3.00.02	Input Output modules, as required in the Control System for all type of field input signals (4-20 mA, non change over/change over type of contact inputs etc.) and outputs from the control system (non change over/change over type of contact, 24/48 VDC output signals for energising interface relays,4-20 mA output etc.) are to be provided by the Contractor. Contractor to refer drawing no. 0000-999-POI-A-065 for interface/termination requirements of Field Instruments/ Drives.		
3.00.03	Electrical isolation of 1.5KV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal-operate the internal processing equipment.		
3.00.04	The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.		
3.00.05	Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input, alternatively suitable combination of inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive system only without affecting other systems.		
3.00.06	All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply.		
3.00.07	The Contractor shall provide the following monitoring features: a Power supply monitoring. b Contact bounce filtering. c Optical isolation between input and output signals with the internal circuits d In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode. The fail-safe mode shall be intimated to the successful Contractor during detailed 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-C5 PLC BASED CONTROL SYSTEM
			PAGE 7 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.00.08	Binary Output modules shall be rated to switch ON/OFF coupling relays of approx. 3 VA at 24 VDC. Analog output modules shall be able to drive an load impedance of 500 Ohms minimum.			
3.00.09	Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware.			
3.00.10	Only one changeover contact shall be provided in MCC for control and interlock requirement. Further multiplication, if required, shall be done by the contractor in PLC system.			
3.00.11	All input fields interrogation voltage shall be 24V DC or 48 V DC.			
3.00.12	In case of loss of I/O communication link with the main processing unit, the I/O shall be able to go to predetermined fail safe mode (to be decided during detailed engineering) with proper annunciation.			
3.01.00	Wiring Scheme for inputs to control system shall be as follows:			
3.01.01	Input used for interlock/protection shall be dual redundant. Each of the redundant binary & analog inputs shall be wired to separate input modules. These redundant modules shall be placed in different racks, which will have separately fused power supply distribution. Implementation of multiple measurement scheme of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group.			
3.01.02	The single (i.e. non-redundant) binary & analog signal required for control purposes shall be wired as follows:			
3.01.03	All single analog & binary inputs including the limit switches of valves/dampers MCC/SWGR check-backs of all drives & information related signals shall be wired to single (i.e. non-redundant) input modules.			
3.01.04	The on-off status of HT drives etc, however, be wired to two input modules in parallel.			
3.01.05	Inputs and Outputs related to each of the redundant drives / equipments (eg. each of the 3x50 % drives, each of the storage vessel/sump/tank storing same fluid, each of the streams and its related drives etc.) shall be wired to separate input and output modules.			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 8 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.02.00	The signal conditioning functions like multiple measurement schemes, square root extraction for flow signals, pressure and temperature compensation, limit value computation can be performed either in the controllers or in signal conditioning and processing hardware outside controllers.			
3.03.00	The maximum number of inputs/outputs to be connected to each type of module shall be as follows:			
	1.	Analog input module	16	
	2.	Analog output module	16	
	3.	Binary input module	32	
	4.	Binary output module	32	
	5.	Analog input & output (combined)	16	
	6.	Binary input and output (combined)	32	
3.04.00	Any single sensor/transducer/transmitter failure alarm shall be provided on programmer station screens for all sensors/transducers/transmitters. Similarly sensor break alarm for thermocouples etc. shall also be displayed on the screens.			
3.05.00	Contractor shall provide remote Input/Output modules Housed in free-standing cabinets/racks (with suitable redundant data link to the central PLC system) as specified. These Input/Output modules shall meet the technical requirements as mentioned in the above clauses. Further these Input/Output modules shall be designed to continuously work under the environment expected to be encountered in assigned areas without any air-conditioning support. Wherever the cable route distance of these I/O cabinets/racks exceeds a distance of 300 meters from the Central PLC, fiber optic data link has to be provided.			
4.00.00	SYSTEM SPARE CAPACITY			
4.01.00	Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, Control System shall have spare capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site:			
4.02.00	10% spare channels in input/output modules fully wired up to cabinets TB.			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 9 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.03.00	Wired-in "usable" space for 20% modules in each of the system cabinets for mounting electronic modules wired up to corresponding spare terminals in system cabinets. Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Contractor shall not be considered as wired-in "usable" space for I/O modules. Terminal assemblies (if any in the offered system), corresponding to the I/O modules shall be provided for above mentioned 20 % blank space.			
4.04.00	Each processor / controller shall have 30% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each processor / controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type including above specified spare requirements, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of processor/controller.			
4.05.00	The Data communication system shall have the capacity to handle the additions mentioned above.			
4.06.00	Twenty (20) percent spare relays of each type and rating mounted and wired in cabinets TB. All contacts of relays shall be terminated in terminal blocks of cabinets.			
4.07.00	The spare capacity as specified above shall be uniformly distributed throughout all cubicles. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time / duty cycle, etc. from those stipulated under this specification.			
5.00.00	DATA COMMUNICATION SYSTEM (DCS)			
5.01.00	The Data Communication System shall include a redundant Main System Bus with hot back-up. Other applicable bus systems like cubicle bus, local bus, I/O bus etc shall be redundant except for backplane buses which can be non-redundant. The DCS shall have the following minimum features : a Redundant communication controllers shall be provided to handle the communication between I/O Modules (including remote I/O) and PLCs and between PLCs and operator work station. b The design shall be such as to minimise interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 10 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	station/module connected to the system bus shall not result in loss of any communication function to and from any other station/module. c If the system bus requires a master bus controller philosophy, it shall employ redundant master bus controller with automatic switchover facility. d Built-in diagnostics shall be provided for easy fault detection. Communication error detection and correction facility (ECC) shall be provided at all levels of communication. Failure of one bus and changeover to the standby system bus shall be automatic and completely bump less and the same shall be suitably alarmed/logged. e The design and installation of the system bus shall take care of the environmental conditions as applicable. f Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus 25% spare capacity shall be available for future expansion. g Passive coaxial cables or fibre optic cables shall be employed. The Contractor shall furnish details regarding the communication system like communication protocol, bus utilisation calculations etc.			
5.02.00	The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 100 milli seconds under the most arduous control system operating conditions.			
5.03.00	Controls/Open Loop Control System (OLCS) Functions			
5.03.01	These clauses are applicable for all the Binary controls of PLC included in Contractor’s Scope including all the control logics of FGD system.			
5.03.02	The OLCS shall include sequence control, interlock & protection for various plant auxiliaries/valves/dampers/drives etc. The sequence control shall provide safe and automatic startup and shutdown of FGD system. The interlock and protection system shall ensure safe operation of FGD system at all times and shall automatically shut down FGD system when unsafe conditions arise.			
5.03.03	The OLCS shall be arranged in the hierarchical control structure consisting of unit level, group level, subgroup level & drive level (as applicable).			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 11 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
5.03.04	It shall be possible to perform automatic FGD startup & shutdown by issuing minimum number of command from OWS. Thus, the unit level shall control all the Control System Blocks and issue appropriate startup & shutdown commands to various blocks of this Control System and receive corresponding commands/check backs/feedbacks.			
5.03.05	The group level shall control a set of functional sub-groups of drives. Appropriate start-up and shut down commands shall be issued to the sub-group control and various check-backs shall be received from sub-groups or drives. Each sub-group shall execute the sequential start-up and shut down programs of a set of inter-related drives along with system interlocks and protections associated with that sub-group as well as basic interlocks and protections related to individual drive falling under that sub-group. The drive level shall accept commands from the sub-groups, push buttons (wherever provided), etc., and transmit them to the respective drive, after taking into account various interlocks and protections and the safety of that particular drive. For HT drive, first-up logic shall be incorporated to indicate the cause of protection/trip.			
5.03.06	Sequence Control 1 A sequence shall be used to move a set of groups, sub-groups from an initial steady state (for instance 'OFF') to a final steady state (for instance 'ON'). The sequence initiating command for the unit & group level shall be issued from OWS. 2 A sequence shall be made of steps. The steps shall be executed in predetermined order according to logic criteria and monitoring time consisting of the interlock & protection requirements and check back of previous step which shall act as preconditions before the sequence control can execute the command for that step. 3 Each step shall have a "waiting time" implying that the subsequent step would not be executed unless the specified time elapses. A monitoring time shall also be defined as the maximum time required in executing the commands of any step and the time required for appearance of check back signals. In case, this is not completed within the specified time, a message shall be displayed and programme will not proceed further. 4 Manual intervention shall be possible at any stage of operation and the sequence control shall be able to continue at the correct point in the programme on return to automatic control. Protection commands shall have priority over manual commands, and manual commands shall prevail over auto commands. 5 Open or close priority shall be selectable for each drive. 6 The sequence startup mode shall be of the following types. - A Automatic Mode - B Semi-Automatic Mode			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 12 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	C Operator Guide Mode / Test Mode			
5.03.07	For the drives, the command shall be provided through redundant O/P module to MCC/SWGR/Actuator as applicable and inputs (status, SWGR & process) shall be acquired through input modules. The failure of one of the redundant output module shall in no way affect the function of the other output module.			
5.03.08	The output modules control module shall have the feature that ensures that in case of failure, all the outputs are driven to zero. The 24V DC command outputs to drives for ON/OPEN, OFF/CLOSE shall be separate and independent and inverted outputs shall not be employed. Keeping +24 V DC extended to the relays for these outputs continuously and extending ground/ negative when command is to be issued is not acceptable except some of the auxiliary plants as to be decided during detailed engineering.			
5.03.09	For inching type of drives, position transmitter power supply and monitoring of position transmitter signal shall be provided.			
5.03.10	The termination for OPEN (ON)/CLOSE (OFF) command for the drive actuator shall be performed in the actuators specified elsewhere in the specification. However, OPEN (ON)/CLOSE (OFF) and disturbance status as a minimum shall be monitored in OLCS.			
5.03.11	The sequence interlock & protection requirements shall be finalized during detailed engineering and the same shall be subject to Employer's approval.			
5.03.12	The drive function i.e. basic interlock & protection logic of the drive shall be implemented in redundant controllers. The drive function shall ensure that protection signals for the safety of the drive shall be effective under all conditions and under all modes of operation. The different commands shall be performed according to the priority of protection 'Off', Protection 'On', manual and automatic. The standard functions like running time monitoring, status signaling, alarm/drive annunciation, etc. shall be performed in drive function. The drive function shall prevent hunting of the actuator in the presence of both open & close commands for actuators of the valves & dampers. The drive function shall be implemented in dedicated standard software functional block.			
5.03.13	The reversible drives to be controlled under OLCS shall be actuators with integral starters. These actuators will have coupling/interposing relays for accepting commands from OLCS and shall provide check back signals to OLCS. As such, all drive related inputs/outputs for reversible drives shall be available from actuators in field. The 'Open' and 'Closed' limit switches of each actuator shall be monitored with selectable delay time to check & alarm the contradictory condition of both contacts indicating 'Open' or 'Closed' status of actuators. The actuators for valves & dampers shall be interfaced as follows :			
5.03.14	The open/close commands and check back signals from limit switches and disturbance signals shall be hardwired to respective OLCS group through I/O modules from actuators in the field.			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 13 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.04.00	Modulating Controls/Closed Loop Control System (CLCS) Functions			
5.04.01	This Clause is applicable for all analog controls of PLC.			
5.04.02	The controller capability shall, as a minimum, include (i) P, PI, PD and PID control functions and their variations (ii) cascade control (iii) feed forward control (iv) On-Off control, (v) Ratio and bias control, (vi) Logical operation .			
5.04.03	The loop reaction time (from change of output of the transmitter/temperature element to the corresponding control command output) shall be within 500 milli seconds. For binary control the response time shall be within 100 milli seconds only.			
5.04.04	The control loop shall have enough flexibility and various features to perform feed forwards, balancing of controller, increasing the response to achieve the desired process parameter within prescribed time frame.			
5.04.05	The control system shall be bumplessly transferred to manual on the conditions of Control power supply failure, Failure of redundant controllers, Field input signal not available, Analog input exceeding preset value, etc. as a minimum and as finalized during detailed engineering.			
5.04.06	Any switch over from auto to manual, manual to auto and switchover from OWS operation to H/A station operation and vice versa shall be bump less and without resulting in any change in the plant regulations and the same shall be reported to the operator and recorded automatically.			
5.04.07	The System being supplied shall be such that when permissible limits are exceeded, an automatic switchover from an operation governed by maximum efficiency, to an operation governed by safety and availability is affected.			
5.04.08	For safety reasons, switchover logics associated with the modulating control loops shall be performed within the closed loop control equipment. Modulating control loops shall be provided with standard features to interface overriding commands from OLCS/Protection System like open, protection open etc.			
5.04.09	All controllers shall be freely configurable with respect to requisite control algorithms.			
6.00.00	SYSTEM REACTION TIME			
6.01.00	The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 100 milli seconds under the most arduous control system operating conditions.			
7.00.00	OPERATOR INTERFACE DISPLAYS/LOGS/REPORTS			
7.01.00	Suitable Operator Interface Displays/Logs/Reports for control operation & monitoring shall be provided. The details shall be finalised during detailed Engg. stage.			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 14 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS																					
7.02.00	Minimum quantities shall be as follows:- 1 Various displays on the OWS shall as a minimum include P&ID displays or mimic, bar chart displays, x-y & x-t plot (trend) displays, operator guidance message displays, group displays, plant start-up/shutdown message displays, system status displays etc. Number of displays and the exact functionality shall be on as required basis and as finalised during detailed engineering subject to the minimum quantities as given in subsequent clauses. For x-t & x-y plots, the facility of providing a background grid on operator request shall be variable with adequate no. Of divisions in both co-ordinates. 2 The Minimum Quantity of Major Types of Displays per unit shall be as follows: <table><tr><td>a)</td><td>Control displays (group/sub-group/sequence/loop)</td><td>(On as reqd. basis subject to 100 minimum)</td></tr><tr><td>b)</td><td>P&ID/ mimic display</td><td>20</td></tr><tr><td>C)</td><td>X-Y Plot (with superimposed operating curves + using user selectable stored data)</td><td>25 + 25</td></tr><tr><td>D)</td><td>Group displays</td><td>20</td></tr><tr><td>E)</td><td>Operator guidance message</td><td>10</td></tr><tr><td>F)</td><td>System status & other diagnostic display</td><td>on as required basis</td></tr></table> The assignment for the above will be done by the contractor as per the requirement of operation of contractor's system as well as for maintenance. The balance displays shall be left as spare for future modification/addition.				a)	Control displays (group/sub-group/sequence/loop)	(On as reqd. basis subject to 100 minimum)	b)	P&ID/ mimic display	20	C)	X-Y Plot (with superimposed operating curves + using user selectable stored data)	25 + 25	D)	Group displays	20	E)	Operator guidance message	10	F)	System status & other diagnostic display	on as required basis
a)	Control displays (group/sub-group/sequence/loop)	(On as reqd. basis subject to 100 minimum)																				
b)	P&ID/ mimic display	20																				
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D)	Group displays	20																				
E)	Operator guidance message	10																				
F)	System status & other diagnostic display	on as required basis																				
8.00.00	HISTORICAL STORAGE AND RETRIEVAL SYSTEM (HSRS)																					
8.00.01	The HSRS shall collect, store and process system data from MMIPIS data base. The data shall be saved online on hard disk and automatically transferred to erasable long term storage media once in every 24 hours periodically for long term storage. Provision shall be made to notify the operator when hard disk is certain percentage full. The disk capacity shall be sufficient to store at least seven days data .																					
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-C5 PLC BASED CONTROL SYSTEM	PAGE 15 OF 27																		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.00.02	The data to be stored in the above system shall include alarm and event list, periodic plant data, selected logs/reports . The data/information to be stored & frequency of storage and retrieval shall be as finalised during detailed engineering. The system shall provide user-friendly operator functions to retrieve the data from historical storage. It shall be possible to retrieve the selected data on OWS or printer in form of trend/report by specifying date, time & period. Further, suitable index files/directories shall also be provided to facilitate the same. The logs/reports for at least last seven (7) days shall be available on the disk.			
8.00.03	In addition to above, the system shall also have facility to store & retrieve important plant data for a very long duration (plant life) on portable long term storage media). These data will include any data from the database as well as processed/computed data based an various calculations/transformation. The retrieved data from long term storage media should be possible to be presented in form of alarms, logs, reports, etc.			
9.00.00	CONTROL & POWER SUPPLY SCHEME			
9.00.01	General Requirements The requirements of Electrical Power Supply system are specified herein on system basis. The Contractor shall be responsible for engineering and furnishing a complete and operational system fully meeting the intent and requirements of this specification including tender drawings and Employer approved drawings during detailed engineering. All equipment and accessories required for completeness of this system shall be furnished by the Contractor whether these are specifically mentioned herein or not. All the equipments and sub systems offered shall be from reputed experienced manufacturers. All system cabinets, enclosures, & distribution boards shall be manufactured, assembled, wired and fully tested as a complete assembly as per the requirements of this specification at the manufacturer's works. The Contractor shall furnish all required equipment cubicles and wiring required for conversion and/or stabilization of the power sources provided by the Employer to all other levels which may be necessary for meeting the individual requirement of equipment/system furnished by him including the panel/desk mounted equipment. 24 V DC power supply system shall be provided as below:- i) 24V DC power supply system for PLC based control system shall comprise of two sets, each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller – one for each rectifier bank, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 X 100% DC distribution board. 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both the sets.			
LOT-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-C5 PLC BASED CONTROL SYSTEM	PAGE 16 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Necessary redundant transformers shall be provided by the contractor to derive the power supply from 415V, 3 phase, 3 wire incomers for above.			
9.01.00	POWER SUPPLY SYSTEM FOR PLC BASED CONTROL PANELS			
9.01.01	Microprocessor based, Intelligent, Modular Power Supply.			
9.01.02	Microprocessor based, intelligent, modular power supply shall be sized to meet connected load requirements and keep the connected battery full charged in Float/ Boost mode. A provision of 10% design margin shall be kept over and above the load requirement. Either of the bank of rectifier modules shall be able to recharge fully discharged battery within 8 hours. It shall also be possible to discharge batteries periodically manually. Each rectifier bank shall have N+1 rectifier modules for all applications. The exact sizing of the rectifiers in one bank shall be as approved by Employer during detailed engineering. While selecting the components and finalizing the cooling arrangements, Bidder to note that these rectifier modules are required to operate at 30-40 % of the rated load for most of the time. While sizing, the temperature derating factor as applicable, is to be considered for arriving at the rating of the modules as per Bidder's manufacturing standard if the modules are rated for lower than the 50 deg. C ambient. For the rectifier bank, matching controller along with applicable software shall be provided to meet system requirements under all modes of operation."			
9.01.03	The rectifier module shall be microprocessor controlled, IGBT/Power MOSFET based, high frequency with active load sharing, designed for single and parallel operation with battery and shall have automatic voltage regulators for a close voltage stability even when AC supply voltage and DC load fluctuates, effective current limiting features, front access design, programmable temperature compensation feature for battery charging and filters on both input and output to minimize harmonics. The rectifier module output regulation shall be +/- 1% or better from no load to full load with an input power supply variation of +/- 10% in voltage and +/- 5% in frequency. In addition to indications / display on rectifier panel, alarms along with relevant analog measurements shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in PLC system. Further isolated 4-20 mA signals shall be provided for important parameters like rectifier bank voltage, rectifier bank current, battery voltage, battery current, DCDB Voltage, DCDB current etc. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering. Necessary provision shall be done in PLC end also.			
9.01.04	"Float / Boost" charge functions shall be provided with alarm / indications.			
9.01.05	Each rectifier bank shall be rated for 100% load requirement and keep the connected battery full charged and one spare rectifier module.			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 17 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS		
9.01.06	The rectifier module circuitry shall be of fail-safe design and failure of any component should not result in any rectifier bank output voltage to increase beyond acceptable limits of the C&I system being fed from it.		
9.01.07	The rectifier module shall be current limited for circuit protection and protection of battery from overcharge. The current limit shall be continuously programmable.		
9.01.08	The rectifier module shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energized.		
9.01.09	The rectifier module shall be fed from 415 V AC, 50 HZ, 3 phase, 3 wire system. Bidder shall provide all required power cables & other accessories etc. from 415 V AC power supply system to his electrical power supply system.		
9.01.10	The full load efficiency of rectifier module at nominal input and output shall be 90%. The ripple content shall be limited to +/- 0.5% of output voltage.		
9.01.11	Bidder shall furnish the equipment complete in all respect along with rectifier module rating & voltage drop calculations, supporting curves / data etc.		
9.01.12	The Controller shall be intelligent, microprocessor controlled for monitoring & control of rectifier modules with features viz. auto / manual battery discharge test, battery reserve time prediction, energy management, float / boost mode control etc.		
9.01.13	All software as required for smooth operation and monitoring of rectifier modules in conjunction with controller & BHMS shall be provided by the Contractor.		
9.02.00	Batteries for PLC system		
9.02.01	The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918. The batteries shall be sized as per relevant IEEE Standards. For sizing calculation, an aging factor of 0.8 and a temperature correction factor as per manufacturer's standard at 4 deg. C electrolyte temperature (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C). Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering. However, Contractor shall consider a suitable voltage drop of 2V from battery room to DCDB and DCDB to load, while sizing the battery.		
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-C5 PLC BASED CONTROL SYSTEM
			PAGE 18 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.03.00	DC DISTRIBUTION BOARD (DCDB) Redundant DC feeders (one from each DCDB) shall supply each of the connected panels. From DCDB / panel to driver/load feeder shall be in scope of Bidder. The exact design, rating & number of feeders of the each redundant DCDB shall be as finalized during detailed engineering and as approved by Employer. However, 25% spare feeder (min. 1 no.) with fuses for each rating shall be provided in each DCDB.			
9.04.00	Battery Health Monitoring System (BHMS) BHMS, wherever applicable, shall include microprocessor based hardware and software to monitor the condition of each battery cell of 24 V DC systems on-line. With BHMS it shall be possible to measure & analyze the minimum and maximum voltage values of each battery-cell so that any damage to battery shall be prevented by pro-active maintenance. BHMS shall communicate with the charger/PLC and provide alarms as finalized by Employer during detailed engineering.			
9.05.00	The UPS Power Supply for various systems shall consist of one or more of the following configurations. Bidder shall clearly bring out in the proposal the redundancy feature along with configuration diagram, single line diagram and data sheets etc. & this shall be finalized subject to employer's approval during detailed engineering. Configuration B : UPS system shall consist of 1 x 100% charger and inverter, 1 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories. The specifications for this UPS configuration shall be as per Cl.No. 9.06.00 to 9.06.05 and specifications for Battery shall be as per Cl. No 9.06.06 for Ni-Cd type Batteries. Configuration C : On line UPS with remote monitoring having a battery backup of 30 min. The batteries for UPS System shall be Sealed Maintenance Free type and shall be as per Control System Vendor's standards.			
9.06.00	UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM The minimum capacity of the UPS at load factor of 0.8 lagging inclusive of 10% design margin at 50 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-C5 PLC BASED CONTROL SYSTEM	PAGE 19 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS 
	The UPS system shall meet the following requirements as a minimum. If UPS KVA rating is applicable at a lower ambient temperature than specified 50 deg.c, the bidder shall consider a derating factor of at least 1.5%/deg.c for arriving at the specified UPS capacity at 50 deg.c ambient. The UPS shall have an overload capacity of 125 % rated capacity for 10 minutes and 150 % rated capacity for 10 seconds. The inverter shall have sufficient capability to clear fault in the maximum rated branch circuit, limited to 8 percent of finally selected ups capacity. 9.06.01 Chargers 9.06.01.01 The chargers shall be self regulating, solid state silicon controlled, full-wave rectifier type designed for single and parallel operation with battery and shall have automatic voltage regulators for close voltage stability even when AC supply voltage fluctuates, effective current limiting features and filters to minimise harmonics. The charger should be capable to fully charge the required batteries as well as supply the full rated load through inverter. Furthermore the charger should be able to re-charge the fully discharged battery within 8 hours. The charger output regulation shall be $\pm 1\%$ from no load to full load with an input power supply variation of $\pm 10\%$ in voltage and $\pm 5\%$ in frequency. In addition to indications/display on charger panel, alarms along with relevant analog measurements shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in DDCMIS. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering. 9.06.01.02 The charger shall be current limited for charger circuit protection and protection of battery from overcharge shall also be provided. The current limit shall be continuously adjustable. The chargers shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energised. 9.06.01.03 The chargers shall be fed from 415V AC, 50 HZ, 3 phase, 3 wire system. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration. 9.06.01.04 The minimum full load efficiency at nominal input and output shall be 90%. The ripple content shall be limited to $\pm 2\%$ of Charger output voltage. 9.06.01.05 The UPS battery shall have sufficient amp-hour capacity to supply the steady state KVA rating of the UPS specified for 60 minute, irrespective of the actual load on UPS. 9.06.01.06 The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit. 9.06.01.07 The UPS system design shall ensure that in case of failure of mains input power supply to one of the chargers, the other charger whose mains input power supply is
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-C5 PLC BASED CONTROL SYSTEM PAGE 20 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.06.02	healthy, shall feed to one or both the inverters as the case may be as per manufacturer's standard practice & continue to charge the D.C. battery at all load conditions. The Bidder should note that this situation should not in any way lead to the discharge of the D.C. Battery.			
	Static Inverters The static inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro-resonant types Inverters are not acceptable. The nominal voltage output shall be 230 Volts. single phase ,50 Hz. The inverter equipment shall include all necessary circuitry and devices to conform to requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. The steady state voltage regulation shall be +/-2% and transient voltage regulation (on application/removal of 100% load) shall be +/-20%. Time to recover from transient to normal voltage shall not be more than 50 mSec. Frequency regulation for all conditions of input supplies, loads and temperature occurring simultaneously or in any combination shall be better than ± 0.5% (automatically controlled). The total harmonic content shall be 5% maximum and content of any single harmonic shall be 3% maximum. The inverter efficiency shall be at least 85% on full load and 80% on 50% load. The synchronisation limit for maintenance of synchronisation between the inverter and stand by AC source shall be 48-52Hz, field adjustable in steps of 1 Hz.			
9.06.03	Static Switch and Manual Bypass Switch The static switch shall be provided to perform the function of transferring UPS loads automatically without any break from (i) faulty inverter to healthy inverter in case of failure of one of the two inverters and (ii) from faulty inverter to standby AC source in case of failure of both the inverters. The transfer time shall be ¼ cycle maximum in synchronous mode. Manual bypass switch shall be employed for isolating the UPS during maintenance. Continuous and overload capacity of the switches shall be equal to 100% of the continuous and overload rating of each inverter. Peak Capacity shall be 1000% of continuous rating for 5 cycles.			
	9.06.04 Step Down Transformer and Voltage Stabiliser One 415V three phase to 230V, single phase transformer along with associated voltage stablizer shall be furnished with each UPS system. The transformer and stablizer combination shall convert Employer furnished 415V ± 10% three phase plant auxiliary AC supply to 230 V ± 2%, single phase standby AC Power Supply source. The transformer shall be of low impedance air-cooled type and its KVA rating and percentage impedance should be selected so that extremely fast fault clearance is achieved.			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 21 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
9.06.05	The overload capacity of the transformer and voltage stabilizer shall not be less than 300% for 200 millisecond duration. The voltage stabilizer shall employ servo-controlled circuitry and shall maintain the specified output voltage for 0-100% load with maximum input voltage variations as indicated above. The efficiency of the stabiliser shall be 95% or better. The type and other details shall be subject to Employer's approval.			
	AC Distribution Board (ACDB) The details of the AC distribution board, i.e. exact, rating and number of feeders etc. of the 2x100% ACDB shall be designed to cater to the requirements of Contractors systems. 25% Spare feeders of each type and rating to be provided in each ACDB.			
9.06.06	The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918. The batteries shall be sized as per relevant IEEE Standards. For sizing calculation, an aging factor of 0.8 and a temperature correction factor as per manufacturer's standard at 4 deg. C electrolyte temperature (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C). Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering. However, Contractor shall consider a suitable voltage drop from battery room to ACDB and ACDB to load, while sizing the battery.			
10.00.00	CONTROL CABINETS / PANELS / DESKS			
10.01.00	The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.			
10.01.01	The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the 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-C5 PLC BASED CONTROL SYSTEM	PAGE 22 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.01.02	The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.			
10.01.03	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.			
10.01.04	Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The finish colors for exterior and interior surfaces shall conform to following shades: (a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalised during detailed engineering. (b.) Interior:- Same as above.			
10.01.05	Paint films which show sags, checks or other imperfections shall not be acceptable.			
10.01.05	As an alternative, single coat of anodic dipcoat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.			
10.01.06	Refer Subsection Basic Design Criteria, Part-B, Section-VI for grounding requirements.			
10.02.00	The mimic shall be configured on the OWS/CRTs and it shall be possible to control, monitor and operate the plant from the same.			
10.03.00	The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section INST CABLE 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-C5 PLC BASED CONTROL SYSTEM	PAGE 23 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.04.00	CONTROL DESK			
10.04.01	Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. A 19 mm thick wooden top shall be provided on the desk to keep the TFT monitors at top and computers inside. Control desk shall consist of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, mouse pads, monitor shelf and concealed cable and wire way management, perforated trays with covers in both horizontal and vertical directions. PA system hand sets, telephone sets, very few PB stations and lamps shall be mounted on the control desk on mosaic grid structure and same shall be decided during detailed engineering. ASCII Keyboard shall be capable of being pulled out through a tray.			
10.04.02	The cabling / wiring between OWS & CPU'S, power supply cables etc. shall be aesthetically routed and concealed from view.			
10.05.00	FURNITURE			
	Chairs – Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back. Chair pedestal shall be made of 5mm thick MS plate covered with poly-propylene cladding. Arm-rests in one piece shall be of poly-urethane and twin wheel castor of glass filled nylon. The exact details shall be finalized & approved by Employer during detailed engineering.			
11.00.00	ANNUNCIATION SYSTEM			
11.01.00	Only OWS based alarm system shall be provided with audio alarm facility (beep/tone generator). No facia annunciation is envisaged in the control room. Hooters are to be provided.			
11.02.00	The system shall display history of alarms in chronological order on any of the OWS. The HMIS shall have the capability to store a minimum of 500 alarms each with paging features allowing the operator to view any page. The system shall have all alarm functions and related function keys like alarm acknowledge, reset, paging, summaries etc. Other design features like set point/dead band adjustments, provision of alarm priority, manual inhibition & automatic inhibition based on predefined logic etc., shall be provided and shall be as finalised during detailed engineering. The alarm display/report format shall be as approved by the Employer.			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 24 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS 
11.03.00	Facility of audio annunciation shall be provided in OWS upon the occurrence OWS alarms irrespective of whether alarms are displayed or not. Facility to disable the audio annunciation shall be provided.
11.04.00	At least three levels of alarm priority shall be available which will be displayed in different colour. It shall be possible to display & print alarms of any of the three levels.
11.05.00	Alarm boxes shall be provided in each display to alert the operator about an alarm when he is viewing some other picture. No of alarm boxes shall be finalised during detailed engineering for each process area & each priority therein.
11.06.00	The annunciator sequence shall conform to ISA sequence ISA-2A.
12.00.00	SOFTWARE DOCUMENTATION AND SOFTWARE LISTINGS
12.01.00	All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the PLC System shall be furnished. The Contractor shall furnish a comprehensive list of all system/application software documentation after system finalization for Employer's review and approval.
12.02.00	All The software listings including Source code for application software, All special - to-project data files etc. shall be submitted by the Contractor.
13.00.00	SOFTWARE LICENCES The Contractor shall provide software license for all software being used in Contractor's System. The software licenses shall be provided for the project (e.g. organisation or site license) and shall not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Employer to seek a new license/renew license due to upgradation/change of hardware/machine in Contractor's System at site. All licenses shall be valid for the continuous service life of the plant. As a customer support, the Contractor shall periodically inform the designated officer of the Employer about the software upgrades/new releases that would be taking place after the system is commissioned so that if required, same can be procured & implemented at site.
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2

CLAUSE NO.	TECHNICAL REQUIREMENTS			
14.00.00	SPECIFICATIONS OF PC BASED OWS			
	CPU	Latest generation CPU		
	Main memory	2 GB expandable to 4 GB		
	DVD R/W	16 x Or higher		
	Hard disk	160 GB SAS		
	Removable bulk storage drive	500 GB (minimum)		
	Monitor	20" Full Flat TFT Resolution with non interfaced refresh rate min 75 Hz.		
	Graphic Memory	128 MB		
	Communication port	2 serial plus, one parallel, 1 USB port, Dual 100 Mbps Ethernet.		
	Expansion slots	3		
	Other Features	101 Keys Keyboard and Optical Mouse		
	Software	a) General MS Windows latest version, MSOffice, Microsoft Visual Studio, Adobe Acrobat, anti-virus McAfee or equivalent, etc. b) Application software - to suit project specific requirement		
15.00.00	PRINTER			
15.01.00	A4 size color laser printer shall be provided as a part of the HMIS system as per Part-A. It shall print out all alarm/trip conditions and event changes in plant status along with date and time of occurrence.			
16.00.00	ANNUAL MAINTENANCE CONTRACT (AMC)			
16.01.00	The Bidder shall provide maintenance services of complete control System under a comprehensive Annual Maintenance Contract (AMC) for period of one year after Warranty period and thereafter AMC for only hardware support for next two years.			
16.02.00	The AMC shall cover total maintenance of all hardware & software coming under the scope of control system and shall include free repair/replacement of all cards/modules/ peripherals/ cables/ components etc., correction of software problems and supply of expendable items. The Bidder shall ensure 99.7% availability of the system with the AMC. Bidder to ensure that system expert is available at site within 48 hours			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 26 OF 27

CLAUSE NO.	TECHNICAL REQUIREMENTS			
16.03.00	of problem reporting by NTPC, in case the solution to the problem is not provided within 24 hours of problem reporting.			
16.04.00	Further, bidder may note that during the AMC he will be allowed to use Employer's mandatory spares and has to replenish the same within three months' time or before completion of AMC period whichever is earlier. However, if in the opinion of the Bidder, more spares than those included in the mandatory spare list are required to meet the availability requirement, then Bidder shall stock the same.			
16.04.00	The Bidder shall prepare detailed list of faults corrected and parts, expendables utilised during AMC period and shall furnish the same to Employer, properly documented at the end of AMC period. Further, during AMC period the details as required by Employer/ Project Manager shall be made available by Bidder's personnel.			
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-C5 PLC BASED CONTROL SYSTEM	PAGE 27 OF 27

SUB-SECTION-III-C6

TYPE TEST REQUIREMENTS

**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		
	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			
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 		
	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-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 3 OF 7

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	

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 4 OF 7
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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
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	

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 5 OF 7
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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
		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	

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 6 OF 7
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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
		Temp rise test without redundant fans	Approved procedure	No	Yes	

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 7 OF 7
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SUB-SECTION-III-C7

CONTROL VALVES, ACTUATORS & ACCESSORIES

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
	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			
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				
			Ambient Temp Effect	<=0.01 %/Deg C Or Better	
	12	EMC & CE Compliance	Required To International Standard Like EN/IEC.	En50081-2& En50082 Or Equivalent	
	13	Accessories	In-built operator panel	Display with push buttons for configuration and display on the Positioner itself (password protected/hardware lock).	
			Press gauge block	For supply & output pressure.	
			Mounting assembly	On as required basis.	
8.00.00	TEST AND EXAMINATION All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:				
8.01.00	Non Destructive Test as per ANSI B-16.34.				
8.02.00	Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.				
8.03.00	Valve closure test and seat leakage test in accordance with ANSI-B 16.34 and as per the leakage class indicated above.				
8.04.00	Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.				
8.05.00	CV Test: Refer Cl.no 3.00.00 (8) Subsection IIIC-06 (Type test requirements)				
9.00.00	CONTROL VALVE QUANTITIES Bidder shall furnish all the control valves under this package as finalised during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.				
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