

**NTPC LIMITED**

**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)**



**TECHNICAL SPECIFICATION**

**FOR**

**HVAC SYSTEM**

**SPECIFICATION NO.: - PE-TS-466- (571-13000-A)-A002**



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



**TITLE:**  
**TECHNICAL SPECIFICATION FOR  
HVAC SYSTEM**

**SPECIFICATION No: PE-TS-466-(571-13000-  
A)-A002**

**SECTION**

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**3x200MW + 4X500MW KORBA TPP  
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## **SECTION-I**

### **SUB-SECTION-A**

#### **INTENT OF SPECIFICATION**



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**1.0 INTENT OF SPECIFICATION**

- 1.1 The specification covers design, engineering, manufacture, supply / procurement, inspection and testing at vendor's / sub vendor's / manufacturer's works, painting, forwarding, proper packing and shipment and delivery at site, unloading, handling & transportation, storage, preservation , security / safety at site , Erection & Commissioning on FOR site basis, Performance and guarantee testing / demonstration testing and handing over to BHEL's customer of **HVAC SYSTEM** as per details in different sections / volumes of this specification and various pre award agreements for **3x200MW + 4X500MW KORBA TPP (FGD SYSTEM PACKAGE)**.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **HVAC SYSTEM**.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.
- 1.5 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed of the specification. In absence of any such clarifications, in case of any contradictory



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requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the format attached with GCC (Annexure-II Deviation sheet (Cost of withdraw), otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, Section - C shall prevail over section – D, however more stringent requirement as per the interpretation of the owner shall apply.
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser Employer, consultant, please refer relevant clause.
- 1.12 The bidder shall visit the site to familiarize themselves with the actual site conditions and the materials already available at site, and shall quote accordingly. No price implication or claim shall be admissible on account of any discrepancy between the bidder's understanding and the actual site conditions.



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PROJECT INFORMATION WITH WIND AND  
SEISMIC DESIGN CRITERIA**

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**SECTION: I  
SUB-SECTION: B  
PROJECT INFORMATION**

CLAUSE NO.	PROJECT INFORMATION			
<p><b>1.00.00</b></p> <p>1.01.00</p> <p>1.02.00</p> <p>1.03.00</p> <p>1.04.00</p>	<p><b>BACKGROUND</b></p> <p>Korba Super Thermal Power Project (KSTPP) was originally conceived as a pit head coal-based power plant. The present capacity of the plant is 2600 MW which has been implemented in 3 stages. Stage-I comprises of three 200 MW units, Stage-II comprises of three 500 MW units and the Stage-III of the plant comprises of one 500 MW unit.</p> <p>The present proposal is for implementation of FGD system in the stage-III (1x500MW) of Korba STPP for reduction of SOx emissions.</p> <p><b>LOCATION AND APPROACH</b></p> <p>The site is located on the western bank of river Hasdeo near Korba town in Korba District of Chhattisgarh State. The site is contiguous to the Right Bank Irrigation Canal emanating from Hasdeo Barrage. BALCO's aluminium plant and two power stations are already located on both the banks of Hasdeo river in the vicinity. Korba town is a broad gauge railhead 37 kms away from Champa railway station on Calcutta-Nagpur main line of South-Eastern Central Railway and is approximately 510 kms from Nagpur by rail. The site is very close to all weather road between Katghora &amp; Korba and is approximately 110 kms from Bilaspur and 10 kms from Korba town.</p> <p>Vicinity plan of the proposed project is placed at <b>Annexure –I</b>.</p> <p><b>LAND</b></p> <p>Wet Limestone Forced Oxidation FGD equipment shall be installed within the existing station premises.</p> <p><b>WATER</b></p> <p>The source of raw water for the project is Right Bank Canal (RBC) originating from Hasdeo Barrage near the Plant boundary. 110 MCM (123 Cusecs) of water for Korba STPP is available from Chhattisgarh Govt.</p> <p><b>Coal Quality Parameters / Fuel Oil Characteristics &amp; Plant Water details:</b></p> <p>(i) The Coal quality parameters and Fuel Oil characteristics are indicated in Table-1 &amp; Table-2 respectively below.</p> <p>(ii) Process water: Process water quality is CW Blowdown based on the COC indicated in Table-4.</p> <p>(iii) Clarified water: Clarified water quality is indicated in Table-4.</p> <p>(iv) DM water for Equipment cooling water system.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB SECTION-II-A4 PROJECT INFORMATION (KSTPP-I, II &amp; III)</p>	<p>PAGE 1 OF 36</p>	



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**TECHNICAL SPECIFICATIONS**



**3x200MW + 4X500MW KORBA TPP  
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**SPECIFIC TECHNICAL REQUIREMENT**



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**1. FUNCTION**

The purpose of the system is to provide HVAC system for different areas of 3x200MW + 4X500MW KORBA TPP (FGD SYSTEM PACKAGE) under the scope of BHEL.

**2. SYSTEM DESCRIPTION**

Basic engineering of HVAC system such as Heat Load Calculation along with supply Air Quantity, Fan schedule, P&ID and Capacities of equipment (such as Condensing unit, AHU, UAF, Axial fan, propeller fan, Louvers, dampers etc.) for Air Conditioning system and Evaporative Cooling system of FGD control room building and Auxiliary buildings are already finalized with customer. Details of the HVAC for FGD system w.r.t mechanical, Civil & Electrical are as under:

**MECHANICAL**

Equipment / layout drawings for specific makes of respective equipment (as per the table1) have been approved by customer and are attached in Section -II, sub section 8. In case successful bidder finalize these makes, it is not required to submit these drawings / documents afresh during detail engineering. However, bidder shall be required to endorse the documents attached in Section-II Sub-Section 8 (during detail engineering).

Further, it may be noted that bidder has the option to choose different makes (other than those for which drawings/ documents have been attached in the specification) for these items from the list of makes of sub vendor items attached at Sub Section E. In such scenario, Bidder will have to submit Engineering Document for such items in line with details mentioned in respective equipment GA/ documents attached at Section-II Sub-Section 8. However, any data which is proprietary in nature or standard for the model offered by OEM or not specifically insisted in this tender specification of the respective equipment may be updated / modified suitably.

**CIVIL**

Civil foundation for HVAC equipment and wall openings for duct, pipe, axial fans, Propeller fan, damper, louvers is already finalized. Irrespective of the final make of the equipment selected, bidder must comply with following civil aspects of the HVAC for FGD in line with drawings enclosed under Section-II, Sub-Section 8. Any deviation in Civil aspect shall not be acceptable.

- Equipment foundation details for Outdoor Units of the Air-Cooled DX type condensing units, AHU room layout along with equipment foundation AHUs and floor & wall opening for AC ducting layout for FGD control room (drg. No. PE-V0-466-(571-13000-A)-A301)
- Equipment foundation details for UAF for FGD control room, Wall opening for ventilation ducting, wall mounted gravity operated damper (drg. No. PE-V0-466-(571-13000-A)-A304)
- Wall opening for axial fans, propeller fan, louvers, dampers of various auxiliary bldg. (Size as per Sub section -C1 and quantity as per Fan schedule drg. No. PE-V0-466-(571-13000-A)-A402)

**Any modification in the civil works required to accommodate the offered equipment—including chipping, refinishing and, repainting to match the existing finish, subject to acceptance by BHEL—shall be in bidder scope.**



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Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

**ELECTRICAL**

Rating as per final feeder list attached at Section-II. Irrespective of the final make of the equipment selected, bidder must comply with following final feeder list in all aspect for the HVAC package for FGD system. Any deviation in Electrical aspect shall not be acceptable.

**TABLE – 1**

S. No.	Equipment	Make as per approved document	Document number / remarks
1.0	Air Cooled DX type Condensing units	Blue star	For details refer Appendix 1 of Section - II, subsection 8
2.0	DX AHU MOTOR	HEM/CG	
3.0	Centrifugal Fan	OEM	
4.0	UAF	OEM	
5.0	Centrifugal Pump	Flowmore	
6.0	Strainer	Sant	
7.0	Valve	Hawa Engineers Ltd.	
8.0	Fire damper	System Air	
9.0	Heater	Alco	
10.0	Humidifier	Rapid cool	
11.0	Axial Fan	OEM	
12.0	Propeller Fan	Crompton Greaves	
13.0	Thermal Insulation	Armacell/ A Flex/ U.P. Twiga/ Lloyd	
14.0	GI Sheet	SAIL/TATA/JSW	
15.0	Filters	As per Approved Vendor List	
16.0	Pipe	Jindal	

**3. SPECIFIC REQUIREMENT:**

- Efficiency of centrifugal fan and pump shall not be less than 70%.
- All ventilation system shall operate on 100% fresh air.
- MODULAR UAF shall have minimum 60% saturation efficiency.
- Ventilation ducts shall be provided with motorized type fire dampers at the supply duct in electrical area like MCC / Switch gear room/ cable spreader room, as well as Electrical areas which will close in case of fire.
- The fire damper shall close the air flow inside the duct on receiving fire alarm signal from FPS. Also, respective fan shall trip once the fire damper is closed.
- > The supporting structure required for the supplied AC and ventilation ducts, and already available at site, shall be within the scope of the bidder.



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

1.	Roof extractor units with 15 mmwc static pressure.		
	Capacity	Motor rating	Roof / Slab opening
a.	40,000 CMH	5.5 KW	1256mm
b.	20,000 CMH	2.2 KW	1000mm
2	Axial flow supply fans with 30 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	10,000 CMH	2.2 KW	1000mmx1000mm
b.	7,500 CMH	1.5 KW	1000mmx1000mm
c.	6,000 CMH	1.1 KW	600mmx600mm
d.	4,000 CMH	0.75 KW	500mmx500mm
3	Axial flow supply fans with 20 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	10,000 CMH	1.5 KW	1000mmx1000mm
b.	7,500 CMH	1.1 KW	1000mmx1000mm
c.	6,000 CMH	1.1 KW	1000mmx1000mm
d.	4,000 CMH	0.75 KW	900mmx900mm



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4	Axial flow exhaust fans (Bifurcated type) with 15 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	15,000 CMH	2.2 KW	1000mmx1000mm
b.	10,000 CMH	1.5 KW	1000mmx1000mm
c.	7,500 CMH	1.1 KW	1000mmx1000mm
d.	4,000 CMH	0.75 KW	700mmx700mm
e.	2,000 CMH	0.55 KW	700mmx700mm
5	Axial flow exhaust fans with 10 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	15,000 CMH	1.1 KW	900mmx900mm
b.	10,000 CMH	0.75 KW	900mmx900mm
c.	7,500 CMH	0.55 KW	700mmx700mm
d.	6,000 CMH	0.55 KW	700mmx700mm
e.	4,000 CMH	0.55 KW	500mmx500mm
f.	2,000 CMH	0.37 KW	500mmx500mm
6	Exhaust fan (propeller type) with 5 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	1000 CMH	100 W	300 mm circular



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**4. GENERAL**

- 1) Basis of design / equipment selection criterion, layout drawings/ schemes/G.A. dwg and documents like data sheet/ technical particulars etc are subject to Customer approval during detail engineering /make approval stage.
- 2) Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.
- 3) All drawings and documents shall be computer based.
- 4) Vendor to include the Back-wash arrangement of pot strainer with gate valve, piping etc for the MODULAR UAF.
- 5) Vendor to include level gauge & level transmitter for each MODULAR UAF tank for alarm & trip of the pumps. Also include one no. Pressure transmitter for each MODULAR UAF pump. Temperature elements, electronic transmitters etc. are to be provided for all the cases. Acceptance of use of process actuated switches is subject to customer approval.
- 6) All commissioning spares & consumables for trouble free operation shall be provided.
- 7) Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL-approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 8) Indicative list of makes is enclosed as per Annexure-I however these equipments / items shall be subject to Customer & BHEL approval during detail engineering Stage.
- 9) Inserts or any support arrangement for fixing ducting, fans, piping etc. shall not be provided by BHEL. Necessary supports may be taken from nearest structure / walls / roofs / floors etc. by Vendor.
- 10) Fixing frame works for diffusers and grilles in the scope of Vendor.
- 11) Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.
- 12) Necessary supports and structures / frames etc. as required for supporting the duct / piping / equipments etc. as lump-sum basis is in the scope of Vendor and no unit rates shall be applicable for these items.
- 13) Drain piping within room up to the drain point to be provided by the Vendor.
- 14) Vendor to furnish schedule of power and control cables. Vendor to furnish cable termination details interconnection drawings etc. during detail engineering stage.
- 15) The tools and machine required for erection of equipment shall be arranged by Vendor.



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- 16) Tools & tackles as required for regular maintenance shall be supplied by Vendor.
- 17) Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.
- 18) Instrument for testing shall be calibrated by Air-conditioning plant supplier before taking up testing.
- 19) Pressure gauges shall have provision for air venting.
- 20) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied (as per attached instrumentation installation diagram)
- 21) Bidders shall guarantee to maintain specified inside design conditions during summer, monsoon and winter and also even if the internal equipment load varies from 100% to 25%.
- 22) Besides the system performance as above, bidder shall guarantee major technical parameters of various equipments as per design basis / details furnished in different section of technical specification.
- 23) The guarantee tests shall cover but not limited to the following rated parameters for smooth operation of air conditioning and ventilation system.
  - Performance test of the Air conditioning system shall be carried out at site after proper installation. The site test shall include performance testing of equipment for minimum 72 continuous hours in summer or monsoon and minimum 24 continuous hours in winter. Bidder, as may be required to carry out site tests shall arrange all instruments, tools etc.
  - All calibrated instruments to be used for the tests at manufacturer's works/site shall be arranged by the bidder. Any Electrical/C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope.
- 24) For group of motorized fire damper / motorised valves, single phase power supply shall be provided by BHEL in AHU room and near MODULAR UAF. Suitable transformer shall be provided by bidder (if required) to derive the power input. Further distribution through junction box / distribution board shall be in vendor scope and shall have provision for isolation of individual fire damper/ valves.
- 25) Tender drawings enclosed form the part of specification and the bidder shall check the space requirements for installing the equipment as per the specification and layout requirements given in the specifications.
- 26) Bidder should suitably group the signals coming from various instruments etc. & the same shall terminate in local JB, from Local JB common cable to DCS / panel / MCC shall be selected. Any Electrical / C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope.



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- 27) In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.
- 28) Bidder to note that BHEL reserve the right for drg/doc submission through web-based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Bidder to ensure proper internet connectivity at their end.
- 29) Quality requirements in the Technical specification are minimum requirements for inspection and testing. Vendor to note that quality plans are subject to Customer approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 30) Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Air-conditioning system vendor.
- 31) Flat, platform type RCC / PCC foundation shall be provided for installing Chiller/ PUMP, AHU and FAN etc. Vendor shall fix the equipment using anchor fasteners to secure the equipment obtain parameters related to vibration and noise.
- 32) Bidder to note that the P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication.
- 33) Supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.
- 34) Each motor terminal box shall be provided with cable gland and lugs for the size and type of power and control cable of respective motor.
- 35) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.
- 36) The bidder's proposal shall be for equipment in accordance with the tech. Specification.
- 37) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification during detail engineering
- 38) Motorized fire damper will be installed at supply air duct in electrical areas like MCC / Switchgear room / cable spreader room etc. in FGD control building. Fire damper will close on receiving fire signal from fire protection system and shall also be possible manually from remote control panel. Also modular UAF shall trip on receiving fire signal from fire protection system.
- 39) All openings required in brick wall for installing the axial supply and exhaust fans, propeller fans, duct opening, louvers and damper openings etc shall be done by BHEL as per opening



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sizes indicated under clause number 7. Any opening requirement on account of change in size of equipment over and above the opening size indicated under clause number 7, same shall be done by vendor along with finishing of opening and painting as per finished wall. Grouting of fans along with anchor fasteners shall be done by vendor. The openings shall be finished properly. In case openings are done once the wall has been painted, repainting, to match with the existing wall paint shall also be done by the vendor. Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Ventilation system vendor.

- 40) Flat, platform type RCC / PCC foundation shall be provided for installing modular UAF and UAF fan / pumps etc. Vendor shall fix the equipment using proper anchor fasteners to secure the equipment and obtain parameter related to vibration and noise.
- 41) All codes and standards shall be as per contract specifications
- 42) Scope of erection by the bidder shall include all equipment supplied by the vendor, as well as the equipment/items already available at site, to ensure completion of the Air Conditioning & Ventilation System in all respects. Performance Guarantee (PG) testing of the entire system shall also be in the bidder's scope.
- 43) Wherever air washer is mentioned (in the complete technical specification) same shall be read as modular UAF and wherever chiller/chilling unit is mentioned (in the complete technical specification) same shall be read as air cooled condensing unit.
- 44) Making Good / Repairing / replacement of and damaged done by bidder to adjacent structure / equipment's / pipes etc. while erecting equipment's related to HVAC System.

**5. EXCLUSIONS**

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

- a) Construction of air handling unit room, foundations for HVAC equipment's.
- b) False ceiling, drop ceiling.
- c) Slab cut out for running ducts, pipes, cables, grilles/dampers. Underground masonry trenches and masonry risers. However minor civil work like making opening to suit / finishing of opening, sealing of duct opening, grouting of foundation bolts including special type of grouting like GPX2 etc. are in the scope of HVAC system vendor.
- d) Provision of drain traps / points,
- e) For Electrical scope, refer Electrical scope matrix sheet.
- f) DCS Control panel for Operation and control of AC System. However, all logic for implementation of control and monitoring from DCS shall be provided by successful bidder during detail engineering.



**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : I**

**SUB-SECTION : C 1**

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**6. CODES AND STANDARDS**

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

- IS-659: Safety code for air-conditioning
  - IS-660: Safety code for mechanical refrigeration
  - ASHRAE-23: Standard method of testing and rating [67 Standards] air conditioner.
  - ARI-450-6: Standards for water cooled refrigerant Condenser.
  - ASME Sec. VII : Unfired pressure vessels
  - IS-4503 : Shell and tube type heat exchanger.
  - ASHRAE 22-72 : Method of testing for rating water cooled refrigerant condenser.
  - ASHRAE-15-2007 : Safe Standard for Refrigeration System
  - ASHRAE-30-1995 : Method of testing liquid chilling packages
  - ANSI-8-31.5 : Refrigeration piping.
  - ANSI-8-9.1 : Safety code for mechanical refrigeration.
  - AR1-410 : Standard for air cooling and air heating coils.
  - AR1-210 : Standard for unitary air conditioning equipment.
  - IS-3588 : Specification for electrical axial flow fans.
  - AMCA-210 : Methods of performance test for fans.
  - BS-2831 : Methods of test for air filters used in AC and general ventilation.
  - IS-4671 : Expanded polystyrene for thermal insulation purpose.
  - IS-702 : Industrial bitumen
  - IS-1239 : Heavy class Pipes for sizes up to 150 mm dia.
  - IS-8188 : For Water conditioning
  - IS-325 : 3 phase induction motors
  - IS-4029 : Guide line for testing 3 phase induction motor
  - IS-210 : Specification grey iron casting
  - IS-2062 : Structural steel
  - AMCA - Bulletin : Standard code of testing centrifugal and axial No. 210 flow fans
  - IS-2825 : Code of practice for welding mild steel
  - IS-2676 : Dimensions for wrought aluminium and aluminium alloy sheets and strips.
  - ASHRAE Code : For various filter
  - ASHRAE-62-2004 : Ventilation rates
  - IS-655 : Specification for metal air ducts
- Pump design and testing should correspond to the procedure mentioned in IS-1520



**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)**

**HVAC SYSTEM  
CUSTOMER SPECIFICATIONS  
TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-466-(571-13000-  
A)-A002**

**SECTION : I**

**SUB-SECTION : C 2A**

**REV. 00**

**SECTION: I**

**SUB-SECTION: C 2A**

**CUSTOMER SPECIFICATIONS  
TECHNICAL REQUIREMENT**

**SUB-SECTION-III-A2**

**AIR CONDITIONING, VENTILATION SYSTEM**

1.00.00

**AIR CONDITIONING SYSTEM****a) General**

The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Complete Air conditioning system consisting of D-X units with refrigerant piping & valves, Air handling units, Hi-wall split air conditioner /Cassette Air conditioners, Packaged Air Conditioners, Fresh air fans, air distribution system (ducting, filters, isolation dampers, motorized fire dampers, diffusers, grills, volume control dampers, etc.) etc., along with all electrical equipment and instrumentation as required for all the buildings which are in the scope of the bidder, as detailed out in Part-B of Section-VI.

**b) Air-conditioning system for F.G.D Control Room Building**

Air cooled condensing units (D-X type) type air conditioners with AHU of suitable capacity with 100 % redundancy (as per actual heat load calculation) shall be provided .

c) SO2 analyzer room (if required) and other air conditioned offices/areas covered under this package shall be provided with Ductable/Non ductable Split air conditioners etc. as per Design criteria specified in Chapter Salient Design Data. Non ductable Split air conditioner shall conform to minimum three (3) star (\*\*\*) rating and above of latest version of Bureau of Energy Efficiency (BEE) HVAC code issued by Ministry of Power, Govt of India.

d) Supply of Mandatory spares as specified.

e) Any additional items required to make the system complete.

f) For Air conditioning system, the Bidder shall provide all Instrumentation systems, accessories and associated equipment, which are included in Bidder's scope, in a fully operational condition acceptable to the Employer. The Bidder shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications.

g) Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of air conditioning system as per manufacturer's standard practice. However relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall be made available in FGD control system. Control and monitoring of air conditioning system from FGD control system is also acceptable.

h) Apart from the above, any area/building which are in the scope of the bidder and require air conditioning, the same shall be provided with air conditioning system, as detailed out in Part-B of Technical Specification.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.02.00	<p><b>Redundancies of equipments:</b></p> <p>100% standby unit shall be kept for FGD control room, analyzer room/Prota cabin (if required) and other air conditioned offices/areas.</p>			
2.00.00	<p><b>VENTILATION SYSTEM</b></p> <p>a) <b>General</b></p> <p>The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Complete Ventilation system consisting of Modular type Unitary air filtration Units, Supply air fans, water pumps, exhaust air fans, louvers, filters, ducting, diffusers, piping, instrumentation etc., for all the buildings which are in the scope of the bidder, as detailed out in Part-B of Section-VI.</p> <p>b) <b>Non-A/C areas of F.G.D Control Room Building</b></p> <p><b>Minimum</b> One (1) nos. of Evaporative type Unitary Air Filtration (UAF) unit (of metallic construction- modular type) of suitable capacity with all accessories, DIDW centrifugal fan (1 x 100%), circulating water pump (1 x 100%), etc. as detailed out in technical specification shall be provided.</p> <p>c) <b>Miscellaneous areas:</b> All other areas like Limestone Grinding system building, Gypsum dewatering building, Recirculation pump &amp; Oxidation blower/compressor building etc &amp; all other non-air conditioned areas covered under this package shall be ventilated by a combination of supply/exhaust fans and fresh air in-take / back draft louvers. For ventilation of Battery rooms and Oil rooms, fans with flame proof motor shall be used. Further, toilets shall be provided with propeller type exhaust air fans.</p> <p>Note1: The above list of Buildings is indicative only. Any Building under this package which are of enclosed type, shall be provided by Mechanical ventilation.</p> <p>Note 2: If open shed is envisaged for any facility, then in that case no mechanical ventilation is required.</p> <p>d) Supply of Mandatory spares as specified.</p> <p>e) Any additional items required to make the system complete.</p> <p>f) For Ventilation system, the Bidder shall provide all Instrumentation systems, accessories and associated equipment, which are included in Bidder's scope, in a fully operational condition acceptable to the Employer. The Contractor shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-..0011-109(3)-9</p>	<p align="center">SUB SECTION-III-A2 AIR CONDITIONING, VENTILATION SYSTEM &amp; COMPRESSED AIR SYSTEM</p>	<p align="center">Page 2 of 4</p>	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
4.00.00	<p>g) Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of ventilation system as per manufacturer's standard practice. Control and monitoring of ventilation system from FGD control system is also acceptable.</p> <p><b>General</b></p> <ul style="list-style-type: none"> <li>i. All associated Civil &amp; structural work for air conditioning and Ventilation system and compressed air system.</li> <li>ii. Set of commissioning spares as may be required during erection and commissioning.</li> <li>iii. One (1) set Special tools and tackles required for maintenance of all the Mechanical, Electrical and C &amp; I equipment under the scope of bidder.</li> <li>iv. All steel / cast iron inserts, plates, bolts, nuts, sleeves, metallic-fasteners etc. to be grouted in concrete work and used to hold/ support the equipment/piping / ducting being supplied and erected under this specifications.</li> <li>v. Any additional items required to make the system complete.</li> </ul>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-..0011-109(3)-9</p>	<p>SUB SECTION-III-A2 AIR CONDITIONING, VENTILATION SYSTEM &amp; COMPRESSED AIR SYSTEM</p>	<p>Page 3 of 4</p>	

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	<p>vi. Initial charge of all lubricants and grease, etc. Further, all consumables required for PG tests shall also be in Bidder's scope of supply. Grouting, dressing and final finishing of all foundations of various equipment, etc.</p> <p>vii. Repairing and making good/ sealing of cutouts / openings in floors, roofs and walls, for executing the works under this system and making them water tight as directed by the engineer.</p> <p>Corrosion protection painting for all equipment / items by Bidder as detailed in relevant clauses of technical specification.</p>			
<p align="center"><b>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p align="center"><b>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-...0011-109(3)-9</b></p>	<p align="center"><b>SUB SECTION-III-A2 AIR CONDITIONING, VENTILATION SYSTEM &amp; COMPRESSED AIR SYSTEM</b></p>	<p align="center">Page 4 of 4</p>	

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

CLAUSE NO.	SALIENT DESIGN DATA			
<p>6.02.00</p> <p>6.02.01</p>	<p>9. Soft water make up (if required) for complete air conditioning system shall be provided by the bidder in-line with terminal point specified in technical specification.</p> <p>10. Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec.</p> <p>11. Air distribution system shall be sized to have a constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/sec.</p> <p>12. Requirement of Underdeck Insulation (for A/C area) (Not In Bidders Scope) Underdeck insulation of 50 mm nominal thickness of glass wool (32 Kg/cu.m) or rock wool (48 Kg/cu.m) shall be provided if</p> <ul style="list-style-type: none"> <li>i) Non A/C area is located just above the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of A/C area.</li> <li>ii) Non A/C area is located just below the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of Non A/C area.</li> <li>iii) Underneath the ceiling of AHU room located below the A/C area or exposed to Atmosphere.</li> </ul> <p>13. AHU's shall be provided with two stage of filtration i.e. pre and fine filter. All fresh air supply shall also be filtered using pre and fine filter.</p> <p>14. A minimum design margin of ten (10) % shall be considered in design of A/C Plant Capacity for each area.</p> <p>15. For areas like FGD control room where load is more than 15TR, direct expansion (D-X) type condensing unit (with AHU) shall be provided. For other areas where air conditioning requirement is 5-15 TR ductable split/package A/C shall be provided. If the air conditioning load is less than 5TR, then Hi-wall Split/Cassette air conditioner shall be provided.</p> <p>16. Insulation for supply and return air ducts: Supply and return ducts shall be insulated. All types of Insulation used for HVAC application shall be CFC/HCFC free.</p> <p><b>6.02.00 REDUNDANCY OF EQUIPMENTS</b></p> <p>6.02.01 Redundancy of various A/C system equipments shall be as follows:</p> <ul style="list-style-type: none"> <li>a) <b>FGD Control Room Building</b> <ul style="list-style-type: none"> <li>i) Air Cooled condensing units Air conditioners: 6 X 33%</li> <li>ii) AHU (VVVFD): 6 X 33%</li> </ul> </li> <li>b) (N+1) standby configuration shall be provided for area served by Cassette / Hi-wall Split/ Ductable split AC/ Package type air conditioners for all other control rooms covered in the scope of this package. Here N stands for number of working ACs</li> <li>c) Fresh air fans shall be 1 x 100 % Capacity for each AHU room.</li> </ul>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-V SALIENT DESIGN DATA</p>	<p>PAGE 15 OF 23</p>	

CLAUSE NO.	SALIENT DESIGN DATA												
6.03.00	<p><b>DESIGN PHILOSOPHY – Ventilation System</b></p> <ol style="list-style-type: none"> <li>1. Air changes per hour in evaporative/ mechanically ventilated areas shall be as follows:               <table border="0" style="margin-left: 20px;"> <tr> <td>i) For all evaporative cooled areas</td> <td style="text-align: center;">-</td> <td style="text-align: right;">8</td> </tr> <tr> <td>ii) General areas</td> <td style="text-align: center;">-</td> <td style="text-align: right;">20</td> </tr> <tr> <td>iii) MCC / Switchgear rooms and Battery rooms &amp; other areas where gaseous fumes/ vapours are generated</td> <td style="text-align: center;">-</td> <td style="text-align: right;">30</td> </tr> </table> </li> <li>2. However in areas producing lot of heat, temperature shall be the criteria as follows:-               <ol style="list-style-type: none"> <li>a) Inside temperature shall be minimum 3 deg.C below the design ambient temperature during summer for evaporative cooled areas.</li> <li>b) Inside Temperature shall be maximum 3 deg.C above the design ambient temperature during summer for mechanically ventilated areas.</li> </ol> <p><b>Note: Dry bulb temperature during summer season mentioned in (Appendix-A) Sub- section V, Part-A shall be considered as Design Ambient Temperature for above.</b></p> <p>The criteria which gives higher number of air changes/higher quantity of air of either of condition (Cl. 1 or 2) flow shall be selected.</p> </li> <li>3. All ventilation systems shall operate on 100% fresh air. All mechanically ventilated areas shall be positively ventilated by means of supply air fans fitted with filters and exhaust fans for ventilation of heat generating areas combination of supply air fans with exhaust air fans shall be provided. MCC / switchgear and cable gallery areas shall be provided with gravity operated back draft dampers in association with supply air fans in order to maintain positive pressure. Battery rooms and other fumes/odour generating areas shall be negatively ventilated by means of exhaust air fans / roof exhausters and intake louvers. All other areas like pump house, Blower/compressor house (if any), etc shall be positively ventilated by a combination of supply air fan and exhaust air fan. Supply air fan catering for electrical areas (MCC &amp; Switchgear rooms) shall be provided with pre-filters and fine filters and for other areas shall be provided with pre-filter only. For Positive ventilation CFM of exhaust air shall be 60% of CFM required for supply air. Similarly for negatively ventilated area, CFM of supply shall be 60% of total CFM exhaust.</li> <li>4. All the equipments of Ventilation system shall be designed for continuous duty.</li> <li>5. The supply air ducts of evaporative type ventilation system entering into switchgear room, cable galleries etc. shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating). Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to</li> </ol>			i) For all evaporative cooled areas	-	8	ii) General areas	-	20	iii) MCC / Switchgear rooms and Battery rooms & other areas where gaseous fumes/ vapours are generated	-	30	
i) For all evaporative cooled areas	-	8											
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iii) MCC / Switchgear rooms and Battery rooms & other areas where gaseous fumes/ vapours are generated	-	30											
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9	SUB-SECTION-V SALIENT DESIGN DATA	PAGE 16 OF 23									

CLAUSE NO.	SALIENT DESIGN DATA			
	<p>operate manually from the remote control panel. Required electrical contacts in control panel of A/C plant and further wiring upto fire alarm panels shall be done by Bidder.</p> <p>6. Circulating water Capacity for Air washer units shall be minimum 0.7 Cu.M/hr per 1000 Cu.M /hr of air flow. Velocity through piping shall be limited to 2.0 m/sec and for gravity flow the same shall be limited to 1.5 m/sec. Air distribution system shall be sized to have a constant frictional drop along its length and air velocity through ducts shall not exceed 12.5 m/sec.</p> <p>7. For pumps, continuous motor rating (at 50°C ambient) shall be atleast 10% above the maximum load demand of the pump in the entire operating range. For fans, compressors and blowers continuous motor rating (at 50°C ambient) shall be atleast 10% above the maximum load demand at the design duty point.</p> <p>8. Supply air fans, exhaust air fans &amp; ventilations of each area shall be provided with local starter panels.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-V SALIENT DESIGN DATA</p>	<p>PAGE 17 OF 23</p>	

CLAUSE NO.	SALIENT DESIGN DATA			
<b>Appendix-A</b> Outside Design Ambient condition to be considered for Air Conditioning system and Ventilation System for various project/station are as under.				
	Location	Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)
	Farakka	Summer	41	25.5
		Monsoon	34.5	27.5
		Winter	15	10
	Kahalgaon	Summer	43	27.5
		Monsoon	38	29
		Winter	6.5	5.5
	Korba	Summer	43.9	25.6
		Monsoon	38.4	27.8
		Winter	15	10
	Ramagundam	Summer	45	27.5
		Monsoon	35.8	28.3
		Winter	12.8	8.9
	Singrauli	Summer	43.5	25.5
		Monsoon	38	27.5
		Winter	15	10
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9	SUB-SECTION-V SALIENT DESIGN DATA	PAGE 18 OF 23	

**SUB-SECTION-I-M2**

**AIR CONDITIONING & VENTILATION SYSTEM**





S.No	Area	Type of Ventilation system
(i)	General area like pump house, buildings etc	Combination of Supply air fan & Exhaust air fans
(ii)	MCCs and Switchgear room etc	Supply air fan & Back draft dampers
(iii)	Battery rooms & Oil rooms and fumes/odor generates	Combination of intake louvers & Exhaust air/ roof extractor fans. Motors shall be flame proof.
(iv)	Toilet/pantry etc	Propeller type exhaust air fan

4.00.00

**EQUIPMENT DESCRIPTION – AIR CONDITIONING SYSTEM**

4.01.00

**Condensing Unit (Air-Cooled D-X type)**

Condensing unit

Type : Air cooled scroll type

Vibration isolators : Steel spring / Neoprene rubber cushy foot type with isolation efficiency not less than 85%.

Compressor

Type : The Compressor shall be scroll, serviceable, either hermetic type or semi-hermetic type with automatic capacity control (minimum 3 steps).

Type of drive : Motor driven, direct or through V-belt.

Refrigerant : The refrigerant shall be R-134a/ R-410A/R-407C or any other environment friendly refrigerant.

Accessories : High/Low pressure cutouts, oil pressure switches, relief valves, pressure gauges at each stage, lube oil and control oil pressure gauges, suction & discharge stop valves, Muffler, Crank case heaters, oil filters, magnetic oil separators, temperature indicators for lube oil/heaters, oil level indicators, safety thermostat for crank case heater, vibration isolators, etc.

Motor Rating : 10% more than the power required by the compressor at 50 deg C design ambient temperature.

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

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p style="text-align: center;">condensing temperature and shall be indicated.</p>		
4.02.00	<p><b>Air Handling Unit (AHU)</b></p>		
4.02.01	<p>Each AHU shall consist of casing, fan impeller section, cooling coil section, damper section, steel frame with anti vibration mountings (AVMs) having minimum 85% vibration dampening efficiency and flame retardant, water proof neoprene impregnated flexible connection on fan discharge. Isolation dampers at the suction and discharge of each AHU shall be provided, in case return air duct is directly connected to AHU. However, in case AHU room is used for return air, isolation dampers are required to be provided only at AHU discharge of each AHU. Pre-filter at the suction and fine (micro-vee type) and absolute (HEPA type) filters (wherever applicable) at the discharge of each individual AHU, and heater section in the common discharge of AHUs shall be provided.</p>		
4.02.02	<p>The casing of AHUs shall be of double skin construction. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 0.63 mm (24g) galvanized steel sheet (thickness of galvanization as per manufacturer's standard) , with 25mm thick polyurethane foam insulation of minimum 38 Kg/Cum density in between. Suitable reinforcements shall be provided to give structural strength to prevent any deformation/buckling.</p>		
4.02.03	<p>Sloping condensate drain pan shall be made of minimum 1.2 mm thick Stainless Sheet Steel. It shall be isolated from bottom floor panel through 25mm thick heavy duty treated for Fire (TF) quality expanded polystyrene or polyurethane foam. Drain pan shall extend beyond the coil.</p>		
4.02.04	<p>Cooling coil (min. 4 row deep) shall be made of seamless copper tubes with aluminium fins firmly bonded to copper tubes and shall be provided with suitable drains and vents connections.</p>		
4.02.05	<p>All filter plenum shall be provided with a walking platform inside the plenum chamber for filter cleaning purpose. Inspection door shall be provided at the plenum chamber and a removable type ladder shall be attached to plenum.</p>		
4.02.06	<p><b>Centrifugal fan for AHU</b></p> <p>a) Fan Type : Double Width Double Inlet (DWDI) Centrifugal Type</p> <p>b) Fan impeller : Backward curved blades</p> <p>c) Casing material : GI /Mild steel with minimum thickness of 3 mm.</p> <p>d) Impeller material : Carbon steel</p> <p>e) Shaft : EN 8 Steel</p>		
<p style="text-align: center;">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p style="text-align: center;">SUB SECTION-I-M2 AIR CONDITIONING &amp; VENTILATION SYSTEM</p>	<p style="text-align: center;">Page 3 of 26</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>f) Fan bearings : Self aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours.</p> <p>g) Critical speed : First critical speed of rotating assembly shall be at least 25% above the operating speed.</p> <p>h) Drive : Motor driven with removable belt guard. Motor driven with removable belt guard. Motor rating (at 50 deg.C ambient) shall be atleast fifteen percent (15%) above the maximum load demand of drives at the design duty point.</p> <p>i) Fans : For AHUs of capacity 50,000 CMH and above, Bidder may offer two (2) Nos. centrifugal fans of equal capacity for each AHU provided all such AHUs are accommodated within the space identified by the Employer.</p>		
4.02.07	<p><b>Mixing Box:</b></p> <p>Mixing box shall be complete with fresh and return air dampers. Mixing box shall be provided whenever the return air is ducted back to the AHU. Further, wherever return air is led back directly to AHU room, no mixing box is required.</p>		
4.02.08	<p><b>Pan Humidifier:</b></p> <p>Pan humidifier shall be made of 22 gauge SS 304 tank, duly insulated with 25 mm thick resin bonded fiber glass insulation (min. 24 Kg/m<sup>3</sup> density) with 0.5 mm GSS cladding. The humidifier shall be complete with stainless steel immersion heaters, safety thermostat, float valve with stainless steel ball, sight glass, overflow and drain connections, steam outlet nozzle and float switch. Step controller shall be provided for switching on / off heater banks as per system requirement.</p>		
4.03.00	<p><b>HI-WALL SPLIT/CASSETTE AIR-CONDITIONERS</b></p>		
4.03.01	<p>Hi-wall Split/cassette air conditioners shall in general consist of the following:</p> <p>i) Casing</p> <p>ii) Hermetically sealed rotary/scroll Compressor</p> <p>iii) Condenser and condenser cooling fan</p> <p>iv) Evaporator along with fan</p> <p>v) Cooling coil</p> <p>vi) Filters</p> <p>vii) Piping, valves, refrigerant strainer, etc.</p>		
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB SECTION-I-M2 AIR CONDITIONING &amp; VENTILATION SYSTEM</p>	<p>Page 4 of 26</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
4.03.02	<p>viii) Controls, instruments, control panel/starter panels.</p> <p>ix) Vibration isolator pads, etc as required.</p> <p>x) Refrigerant as per manufacturer practice.</p> <p>Indoor unit of Ceiling Mounted Cassette Type Unit (Multi Flow Type):</p> <p>The housing of the unit shall be powder coated galvanized steel. All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view.</p> <p>Unit shall have four way supply air grills on sides and return air grill in center.</p> <p>Each unit shall have high lift drain pump and very low operating sound.</p>		
4.04.00	<p><b>SPLIT/PACKAGED AIR CONDITIONERS</b></p>		
4.04.01	<p>Split/packages air conditioners shall in general consist of following:</p> <ol style="list-style-type: none"> <li>I. Casing</li> <li>II. Compressor</li> <li>III. Condenser</li> <li>IV. Evaporator and condenser cooling fan</li> <li>V. Cooling Coil</li> <li>VI. Filters</li> <li>VII. Piping, Valves, refrigerant strainer etc.</li> <li>VIII. Control, instruments, control panel/starter panels.</li> <li>IX. Vibration isolator pads, ducting (if applicable) etc as required.</li> </ol>		
5.00.00	<p><b>EQUIPMENT DESCRIPTION - VENTILATION SYSTEM</b></p>		
5.01.00	<p><b>Unitary Air Filtration</b></p>		
5.01.01	<p>Each modular unitary air filtration shall consist of Casing, Tanks, Fans, Distribution plates, Moisture eliminator and water repellent type nylon filter with frame and support, Header and standpipe with support, Spray and flooding type nozzle. Screen type suction strainer, Pumps, Necessary controls &amp; Instrumentation, and all other required accessories.</p>		
5.01.02	<p>The housing/ casing of air washer unit shall be double skin construction. Double skin panels shall be made of 22G galvanized sheet on outer side and 20G galvanized sheet inside with 25mm thick polyurethane foam insulation of minimum 38 kg/cub. Mtr. Density in between. Frame work for section shall be joined together with soft rubber gasket in between to make the joints air tight. The entire fan section shall be mounted on rolled formed GSS channel frame work.</p>		
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB SECTION-I-M2 AIR CONDITIONING &amp; VENTILATION SYSTEM</p>	<p>Page 5 of 26</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.01.03	<p>The unitary air filtration tank shall be fabricated from MS plate of minimum 6 mm thick and inside and outside surface of the tank shall be spray galvanized (<b>minimum 60 microns DFT</b>). Minimum depth of the tank shall be 600 mm. Tank construction shall be such that the suction screen can be replaced while the unit is operating. Tank shall be provided with overflow, drain with valve, float valve makeup connection with a gate valve backup, quick fill connection with globe valve etc. The overflow pipe shall be connected to drain pipe after isolating valve on drain pipe.</p>			
5.01.04	<p>The distribution plate shall be fabricated out of 18G galvanized steel sheets &amp; galvanized steel angle supports with minimum 50% free area.</p>			
5.01.05	<p>Unitary air filtration shall be one-bank construction. All header and stand pipes shall be galvanized. Cat walks of suitable width shall be provided for maintenance of nozzle, filter etc.</p>			
5.01.06	<p>The spray nozzles shall be of brass or bronze with chrome plating and shall be self cleaning type. The nozzle shall be designed to produce fine atomised spray and shall be properly spaced to give a uniform coverage of the air washer section. The pressure drop through the nozzle should be in the range of 1.4 to 2.4 Kg/cm<sup>2</sup>.</p>			
5.01.07	<p>The eliminator plates shall be of 24G thick GS sheets class 275 or from 100% virgin PVC of minimum finished thickness of 2 mm. The eliminator section made of GSS shall have minimum six bends. The PVC eliminators shall be UV stabilised using Titanium di-oxide and shall withstand the weathering test as per IS:4892 for 500 hrs. Type test report of the compound testing carried out in any reputed laboratory shall be submitted for approval. All supports, tie rods and space bar shall be of either galvanized steel or PVC construction and shall be complete with suitable drip tray and drain pipe.</p>			
5.01.08	<p>Air tight inspection doors of suitable size shall be provided for suction chamber. Spray chamber and fan suction for easy accessibility and maintenance and a water marine light be provided for each unitary air filtration.</p>			
5.01.09	<p>Suitable number of brass screen shall be provided in the air washer tank to arrest the dirt entering the circulating water pump suction. Suitable GI grid shall be used inside the screen for reinforcement.</p>			
5.01.10	<p>The specification for centrifugal fans shall generally be as indicated below. However, the fan shall be of DIDW type for UAF unit.</p>			
5.01.11	<p>Saturation efficiency of Unitary Air Filtration units shall be minimum 60%.</p>			
<b>5.02.00</b>	<b>Centrifugal Fan</b>			
5.02.01	<p>The casing shall be of welded construction fabricated with heavy gauge galvanized sheet steel or MS sheet with spray galvanization (<b>minimum 60 micron DFT</b>). The minimum thickness of casing shall be 3 mm. It shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed air-tight. Split casings shall be provided on larger sizes of fans. Casing drain with valves shall be provided wherever required.</p> <p>The impeller shall have die-formed backward-curved blades tie welded to the rim and back plate to have a non overloading characteristic of the fan. Rim shall be spun to have a smooth contour. If required intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished wherever required. The impeller, pulley and shaft sleeves shall be secured to the shaft by key and/or nuts.</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.02.02	The bearing shall be self aligning, heavy duty ball, roller or sleeve bearing. They shall be adequately supported. They shall be easily accessible and lubricated properly from outside.		
5.02.03	Inlet guard shall be spun to have a smooth contour. Inlet screen, if provided, shall be of galvanised wire mesh of 25 mm square.		
5.02.04	Base plate with necessary number of spring type vibration isolators or ribbed neoprene rubber pad or cushy foot mounting shall be provided. The vibration isolators should have a minimum of 70% efficiency.		
5.02.05	The first critical speed of the rotating assembly shall be at least 25% above the opening speed.		
5.02.06	The fans shall be provided with V-belts and sheaves. All belts shall be sized for 150% rated HP. All V-belt shall be equipped with removable belt guards that do not impede the air flow to the fan inlet. There shall be a minimum of two belts per drive. Motor rating (at 50 deg.C ambient) shall be atleast fifteen percent (15%) above the maximum load demand of drives at the design duty point.		
<b>5.03.0</b>	<b>Roof Ventilators (If applicable)</b>		
5.03.01	The roof extractors shall be “COWL” type.		
5.03.02	Impeller shall be of axial flow type, cast Aluminium in one piece and dynamically balanced. Casing shall be heavy gauge sheet steel construction of 3 mm thick for impeller upto 750 mm diameter and 5 mm for fans with impeller of diameter 750 and above. In casing, access door with locking arrangement be provided.		
5.03.03	The cowl shall be designed for weather protection of the fan also inside of the roof on which the extractor is installed. Galvanised bird screen of 15 mm Square be provided with the cowl. All accessories, steel supports as required will be provided.		
5.03.04	The speed of the fan be limited as per limitation given above for axial fans.		
5.03.05	All accessories rain protection exhaust hood, transformation piece, vibration isolators, steel supports vibration isolators, bird screen, etc. as required shall be provided.		
5.03.06	The vibration level for fans shall be as per ISO: 14694.		
<b>5.04.00</b>	<b>Centrifugal Pumps</b>		
	a) Type	:	Horizontal Centrifugal, Axially or radial split type casing pump or end suction, top discharge horizontal centrifugal pump
	b) Impeller	:	Closed type
	c) Material of Construction		
	i) Casing	:	2% Ni Cast Iron : IS:210 Gr. FG-260
	ii) Impeller	:	Bronze IS:318 Gr-2
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">SUB SECTION-I-M2 AIR CONDITIONING &amp; VENTILATION SYSTEM</p>	<p align="center">Page 7 of 26</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<ul style="list-style-type: none"> <li>iii) Wearing rings : Bronze</li> <li>iv) Shaft : SS 316</li> <li>v) Shaft sleeve : SS 316</li> <li>vi) Lantern ring : Brass / Bronze</li> <li>vii) Packing : Asbestos free</li> <li>viii) Base Plate : Carbon steel as per IS:2062</li> <li>ix) Speed : Maximum 1500 rpm</li> <li>x) Other requirements : To refer to <b>Annexure-I</b> titled “Horizontal Pumps” of this sub section.</li> </ul>	
<b>5.05.0</b>	<b>Axial Fans</b>	
5.05.01	These fans shall have fixed / variable pitch cast aluminum blades of aerofoil design.	
5.05.02	The fan casing shall be of heavy gauge sheet steel construction.	
5.05.03	Necessary rain protection cowl, inlet and outlet cones, bird protection screen, adjustable damper, vibration isolators, back draft dampers etc. shall be provided.	
5.05.04	The speed of the fan shall not exceed 960 rpm for fan with impeller diameter above 450 mm and 1400 rpm for fan with impeller diameter 450 mm or less. However for fans having static pressure of 30 mm WC or above the speed of the fan shall not exceed 1440 rpm for fan with impeller diameter of above 450 mm and 2800 rpm for fan with impeller diameter of 450 mm or less. The first critical speed of rotating assembly shall be atleast 25% above the operating speed.	
5.05.05	All other accessories like supporting structure etc. as required shall be provided.	
5.05.06	Fans of capacity 1000 m <sup>3</sup> /hr & lower shall be of propeller exhaust type.	
<b>6.00.00</b>	<b>BALANCE EQUIPMENT SPECIFICATION</b>	
6.01.00	<b>Material of Construction for Piping &amp; Fittings</b>	
	<ul style="list-style-type: none"> <li>a) Piping for Chilled and Condenser water lines : Heavy grade-IS:1239 or Equivalent upto150 NB and IS:3589 or Equivalent for pipes beyond 200 NB with thickness as indicated in <b>Annexure-II</b></li> </ul>	
	<ul style="list-style-type: none"> <li>b) Refrigerant piping : Seamless steel tubes conforming heavy grade IS:1239 or copper tubes as per IS:2501 (copper material as per IS:191 hard copper grade).</li> </ul>	
	<ul style="list-style-type: none"> <li>c) Drain piping : Same as (a) above &amp; galvanized as per IS:4736.</li> </ul>	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>d) Fittings : 1) The steel fittings shall conform to ASTM A234 Gr. WPB and dimensional standard to ANSI B 16.9/ANSI B16.11 / equivalent for sizes 65 NB and above.</p> <p>2) For sizes 50 NB and below, the material shall conform to ASTM A-105.</p> <p>3) All steel flanges shall be of slip on type and shall conform to ANSI B 16.5</p> <p>4) For pipe sizes above 350 NB, fabricated fittings from sheets of adequate thickness may be used. The bend radius in case of mitre bends shall be minimum 1.5 times the nominal pipe diameter and angle between two adjacent sections shall not be more than 22.5 deg and shall be as per BS:2633/BS:534.</p> <p>5) Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B31.5</p>		
6.02.00	<b>VALVES</b>		
6.02.01	Valves shall have full sizes port and suitable for horizontal and as well as vertical installation.		
6.02.02	Valves for regulating duty shall be of globe type suitable for controlling throughout its lift.		
6.02.03	All safety /relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.		
6.02.04	Valves shall be furnished with back seating arrangement for repacking while working under full working pressure.		
6.02.05	Manual gear operators be provided for valves of size 200 NB and above.		
6.02.06	All valves shall be supplied with companion flanges, nut, bolts & washers, etc.		
6.02.07	The refrigerant line valves shall have steel or brass body with TEFLON gland packing. The construction of disc shall be either globe or angle type. The valve seat shall have white metal lining or equivalent.		
6.02.08	Gate valves shall be of Cast Iron body (confirming to IS:210 Gr FG 220/equivalent) for sizes 65 NB and above conforming to FIS :14846. Gun Metal construction for sizes less than 65NB shall be as per IS:778. Butterfly valves shall conform to latest revision of BS:5155 or equivalent standard of required class/rating.		
6.03.00	<b>AIR FILTERS</b>		
6.03.01	<p><b>Pre Filter</b></p> <p>1) Type : Flange / Cassette</p> <p>2) Pre-filter shall contain washable non-woven synthetic fiber or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side &amp; Aluminium</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.03.02	<p>expanded metal on exit side or G.I. wire mesh on both sides.</p> <p>3) <b>Other requirements : (as applicable)</b></p> <p>a) Suitable aluminium spacers be provided for uniform air flow;</p> <p>b) Casing shall be provided with neoprene sponge rubber sealing.</p> <p>c) Capable of being cleaned by water flushing.</p> <p>d) Density of filter medium shall increase in the direction of air flow in case of metallic filter.</p> <p>e) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria &amp; frost.</p> <p>4) <b>Efficiency :</b></p> <p>Average arrestance of 65 - 80 % when tested in accordance with BS:6540/ASHRAE – 52 – 76 / EN-779.</p> <p>5) Minimum thickness : 50 mm</p> <p>6) Face Velocity : Not more than 2.5 m/sec.</p> <p>7) Pressure drop : Initial pressure drop - Not to exceed 5.0 mm WC at rated flow. Final pressure drop - Upto 7.5 mm WC.</p> <p>8) Location : a) At the suction of each AHUs : b) At the suction of each Fresh air fan</p> <p><b>Fine Filters (Microvee type)</b></p> <p>1) Type : Flange / Cassette</p> <p>2) Fine filter shall contain washable non-woven synthetic fibre or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side &amp; Aluminium expanded metal on exit side or G.I. wire mesh on both sides.</p> <p>3) Other requirements : a) A neoprene sponge rubber sealing shall be provided on either face of the filter frame. b) Capable of being cleaned by air or water flushing. c) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria &amp; frost.</p>		
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">SUB SECTION-I-M2 AIR CONDITIONING &amp; VENTILATION SYSTEM</p>	<p align="center">Page 10 of 26</p>

- 4) Efficiency : Average arrestance > 90% when tested in accordance with BS:6540/ASHRAE-52-76 / EN-779.
- 5) Minimum thickness : 150 mm or 300 mm.
- 6) Face Velocity : Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm.
- 7) Pressure drop : Initial pressure drop - Not to exceed 10 mm WC at rated flow ; Final pressure drop-Up to 25 mm WC.
- 8) Location : i) At the discharge of each individual AHU.  
ii) At the discharge of each Fresh air fan.

6.04.00 **LOW PRESSURE AIR DISTRIBUTION SYSTEM**

6.04.01 Material of air distribution system shall be through galvanized steel sheet (Conforming to Class 275 of IS :277) or Aluminium alloy (grade 19000 / SIC or 3100 / NS3 of IS:737). GI Sheets should be galvanized and galvanizing shall be of 275 gms/sq.m. (total coating on both sides) both for site fabricated and factory fabricated ducts.

6.04.02 **Thickness of rectangular ducts shall be as follows:**

Larger Dimension of duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)
up to 750 mm	0.63 (24 G)	0.80
751 to 1500	0.80 (22 G)	1.00
1501 to 2250	1.00 (20 G)	1.50
2251 & above	1.25 (18 G)	1.80

6.04.03 **Thickness of round ducts shall be as follows:**

Diameter of Round duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)
150 to 500	0.63	0.80
501 to 750	0.80	1.00
751 to 1000	0.80	1.00
1001 to 1250	1.00	1.50
1251 & above	1.25	1.80

CLAUSE NO.	TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
6.04.04	<p><b>Duct Fabrication and Supports:</b></p> <p>a) Duct fabrication shall be as per the latest relevant BIS/SMACNA standard.</p> <p>b) Ducts for A/C system may be <b>site fabricated or factory fabricated</b>.</p> <p>c) The ducts routed inside the buildings with larger side greater than 2250 mm shall be supported by 16mm MS rods and 50x50x3 mm MS double Angles while those below 2250 mm shall be supported by 10mm MS Rods and 40x40x3 MS angles. The duct supports shall be at a distance of not more than 2000 mm for A/C system. The MS rods for these ducts routed inside the building shall be hung from the existing floor beams/wall beams/roof beams/columns with provision of necessary auxiliary or special steel members or by hooks or can be provided by dash fasteners fixed to the ceiling slab. No supports shall be taken from horizontal/vertical bracings of the structures. All items of duct support including MS rods, MS angles and double angles, auxiliary or special steel members, hooks, dash fasteners coach screws and all other supporting material required shall be provided by the bidder. Where ever ducts are running outside the building and or at locations where it is not possible to support the ducts from ceiling/floor due to non-availability of the same, the base steel frame/truss work and other auxiliary steel members, hooks, rods, etc. for supporting the duct work shall also be provided by the Bidder.</p> <p>d) Where the sheet metal duct connects to the intake or discharge of fan units a flexible connection of fire retarding, at least 150 mm width shall be provided of closely woven, rubber impregnated double layer asbestos/canvas or neoprene coated fibre glass.</p> <p>e) All curves, bends, off-sets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have the same velocity as in the main duct to which the branch duct is connected.</p> <p>f) Wherever duct passes through a wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to the adjoining space.</p> <p>g) Wherever pipe hangers or rods pass through the ducts, light and streamline easement around the same shall be provided to maintain smooth flow of air.</p> <p>h) Access doors shall be provided in the duct work or casing on the both sides of the equipment to be serviced. All access doors shall be of adequate size and shall be lined with substantial felt edging to prevent air leakage. Access doors shall be of built up construction, structurally strong and each shall have at least two hinges. Access doors shall have two rust proof window sash of approved type. All doors shall be set so as to flush with insulation or plaster finish on the duct.</p>			
6.04.05	Splitters and dampers shall be provided for equipment/area isolation and for proportional volume control of system. The same shall be minimum 16 gauge GS			
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6.04.06

sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position.

**Factory fabricated ducts :**

- i) All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I.
- ii) Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards-Metal and Flexible-Second Edition-1995" SMACNA)
- iii) All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory fabricated by utilizing the machines and processes as specified in SMACNA or by equivalent technology. In equivalent method, the fabrication shall be done by utilizing the following machines and process to provide the requisite quality of ducts and speed of supply:
  - a) Coil lines to ensure location of longitudinal seams at corners/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.
  - b) All ducts, transformation pieces and fittings to be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines.
  - c) All edges to be machine treated using lock formers, flangers and roll-bending for turning up edges.
  - d) Sealant dispensing equipment should be used for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified. Sealing of longitudinal joint is compulsory for the ducts over 2" w.g. static pressure
- iv) All transverse connectors shall be 4-bolt slip-on flange system with built-in sealant, if any. To avoid any leakage additional sealant shall be used.
- v) Factory fabricated ducts shall have the thickness of the sheet as follows:

Sl.No.	Size of Duct	Sheet Thickness
i)	upto 750 mm	0.63 mm
ii)	751 mm to 1500 mm	0.80 mm
iii)	1501 mm to 2250 mm	1.00 mm
iv)	2251 mm and above	1.25 mm

6.05.00

**Diffusers, Grills & Dampers :**

6.05.01

Supply air diffusers/grills with factory fitted volume control dampers be provided for all air-conditioned areas.

6.05.02

Return air diffusers of air-conditioned areas shall be without volume control dampers.

6.05.03

The diffusers/grills shall be of extruded Aluminum of minimum 1.2 mm thick with powder coating. The colour of power coating shall be as per the interior décor.

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6.05.04	Supply air grills shall be of double deflection type and return air grills shall be of single deflection type.		
6.05.05	All volume control (VC) damper shall be operated by a key from the front of the grills/diffusers and shall be of GI sheet.		
6.05.06	The thickness of VC dampers shall be of minimum 20 gauge and thickness of louvers shall be of minimum 22 gauge.		
6.05.07	Suitable vanes shall be provided in the duct collar to have uniform and proper air distribution. Bank of Baffles wherever required shall also be provided.		
6.05.08	Fire dampers shall be motor operated type and shall have fire rating of minimum 90 minutes.		
6.05.09	All plenum chambers of connections to fans, dampers etc shall be constructed in 18 gauge GS sheet and supported on MS angle frames.		
6.05.10	All ducting surfaces coming in contact with corrosive fumes or gases shall be painted with three coats of epoxy paint over a coat of suitable primer.		
<b>6.06.0</b>	<b>Thermal and Acoustic Insulation</b>		
<b>6.06.01</b>	<b>A) <u>Application with Glass Wool / Rockwool</u></b>		
	(i) All surfaces to be insulated both thermally and acoustically shall be thoroughly cleaned, dried and an adhesive (CPRX compound of Shalimar Tar Products / Loid bond 83 or Equivalent) be applied @ 1.5 Kg /Sqm on the surface.		
	(ii) Insulation material (either expanded polystyrene foam or Glass Wool/ Glass fiber / Rockwool) shall be struck to the surface. All the joints shall be sealed with bitumen.		
	(iii) Insulation mass to be covered with 500 gauge polythene sheet with 50 mm overlaps and sealing all joints on hot side or alternatively aluminum foil can be used which can come as lamination over insulation.		
	(iv) Insulation Finish of types specified under shall be provided thereafter..		
	<b>B) <u>Application with Nitrile Rubber</u></b>		
	(i) All surfaces to be insulated shall be properly cleaned.		
	(ii) A suitable adhesive such as SR 998 or equivalent shall be applied over the surfaces to be insulated and insulation material surfaces.		
	(iii) Insulating material shall than be pasted onto the surfaces in a manner to avoid stretching and any air entrapment within.		
	(iv) Two layers of Glass Cloth with a suitable adhesive as SR 998 or equivalent shall be then applied over the insulating material to avoid surface weathering.		
	<b>C) <u>Application with Polyurethane Foam &amp; Polyisocyanurate Foam</u></b>		
	i) All surfaces to be insulated shall be cleaned.		
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9	SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM	Page 14 of 26

- ii) A suitable adhesive such as CPRX or Loid Bond 83 or equivalent shall be applied over the surface to be insulated and insulation material surfaces.
- iii) Insulating material with aluminum foil lamination shall then be pasted onto the surface in a manner to avoid stretching and any air entrapment within.
- iv) Two layers of Glass Cloth with a suitable adhesive as Loid Bond 130 shall be then applied over the insulating material, to avoid surface weathering.
- v) Insulation Finish of types specified under shall be provided thereafter.

6.06.02

Type of Insulation & Finish

Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
1.	Supply & return air duct of AC System	Resin bonded glass wool	Roll /Slab	50	F-3
		or			
		Closed Cell Elastomeric Nitrile Rubber	sheet	19	As per manufacturer std.
		or			
		Polyisocyanurate Foam	Slab	30	F-3
2.	Refrigerant (Suction and liquid lines)	Closed Cell Elastomeric Nitrile Rubber	tube	19	As per manufacturer std.
		or			
		Rigid Polyurethane Foam	Pipe Section	50	F-1 (a)
3.	AHU drain pipe	Closed Cell Elastomeric Nitrile Rubber	tube	19	As per manufacturer std.
		or			
		Rigid Polyurethane Foam	Pipe Section	50	F-1 (a)
4.	AHU condensate pan (insulation)	Mineral wool or resin bonded glass wool	Slab	25	As per manufacturer std.



Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
	if required)				
5.	Chilled water piping, valves & specialties	Resin bonded Mineral wool or resin bonded glass wool	Pipe section	75	F-1/F-3
		or Rigid Polyurethane Foam	Pipe Section	50	F-3
6.	Chiller (insulation if required)	----- As per manufacturer std.-----			
7.	Chilled water pumps	Resin bonded Rockwool wool or resin bonded glass wool	Slab	75	F-1/ F-3
		or Rigid Polyurethane Foam	Slab	50	F-3
8.	Expansion tank with associated piping	Resin bonded Rockwool wool or resin bonded glass wool	Slab/ Pipe section	75	F-1/ F-3
		or Rigid Polyurethane Foam	Slab	50	F-3
9.	Acoustic insulation of duct	Resin bonded Glass wool	Slab	25	As per specifications
10.	Exposed air duct	Resin bonded Glass wool/Rockwool	Roll/Slab	50	F-4
		or Polyisocyanurate	Slab	50	F-4(a)



6.06.03

Specification for insulation shall be as follows: -

Insulation Material	Code	Thermal conductivity (w/m/°C)	Density Kg/m <sup>3</sup>
Resin bonded glass wool	IS:8183	0.049 at 50°C  0.043 at 50°C	i) 24 (For Glass wool) ii) 48 (For Rockwool) iii) 48(For acoustic insulation)
Mineral wool pipe section. Min.Gr.2	IS:9842	0.043 at 50°C	144
Closed Cell Elastomeric Nitrile Rubber		0.036 at 20°C	40 – 60
Polyurethane Foam	IS12436	0.03 at 50 °C	34 ± 2
Polyisocyanurate Foam		0.03 at 50 °C	34 ± 2

Note : Insulation used for HVAC application shall be CFC/HCFC free

6.06.04

The specification for various finishes shall be as follows

a)	<p><b>Finish F-1 ( with Resin Bonded Glass Wool/Resin Bonded Mineral Wool)</b></p> <p><u>Step-1</u> Wrapping of Poly-Bonded Hessain (PBH – to act as vapour seal) on outer surface of insulation with 50 mm overlap stitching and sealing of overlap with synthetic adhesive like CPRX or Equivalent compound.</p> <p><u>Step-2</u> The surface then shall be wrapped with 19 mm mesh 24 SWG GI wire netting, butting all the joints and laced down with 22 SWG lacing wire.</p>
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	<p><u>Step-3</u> Sand cement (4:1) plaster shall be applied in two layers totalling to 12.5 mm thick, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.</p>
aa)	<p><b>Finish F-1(a) (With Polyurethane Foam &amp; Polyisocyanurate Foam)</b> Wrapping of two layers of 7 mil 10 x 10 mesh glass cloth dipped in suitable adhesive such as SR 998 or Loid Bond 130 equivalent</p>
b)	<p><b>Finish F-2</b></p> <p><u>Step-1</u> Insulation shall be covered with 500g polythene with 50mm overlap and sealing of overlap with synthetic adhesive like CPRX/ Loid Bond 83 or Equivalent compound.</p>
	<p><u>Step-2</u> Same as Step-2 of Finish F-1 above.</p>
	<p><u>Step-3</u> Same as Step-3 of Finish F-1 above.</p>
c)	<p><b>Finish F-3</b></p> <p><u>Step-1</u> Same as Step-1 of Finish F-2 above</p>
	<p><u>Step-2</u> The polythene shall be covered with 26 gauge Aluminium sheet and locking of joints with self-locking screws at a pitch of minimum 100 mm.</p>
d)	<p><b>Finish F-4</b></p> <p><u>Step-1</u> Same as Step-1 of Finish F-1 above.</p> <p><u>Step-2</u> Same as Step-2 of Finish F-1 above.</p> <p><u>Step-3</u> Same as Step-3 of Finish F-1 above.</p> <p><u>Step-4</u> Application of 3 mm thick coat of suitable water proofing compound and wrapped with fibre glass RP tissue followed by final coat of 3 mm thick water proofing compound over the RP tissue.</p> <p><u>Step-5</u> After the above treatment, 22G Aluminium sheet cladding, properly stiched at all joints shall be provided over the external surface.</p>
dd)	<p><b>Finish F-4(a) (With FR Closed Cell Chemically Cross Linked Polyethylene)</b></p> <p>Application of aluminium sheet 22G cladding to be provided over the XLPE insulating material. Cladding sheet is held in position with SDST screws @ 150 mm C/c over tongue-in-groove joints applied with a felt for sealing joint against water ingress.</p> <p>All sheet joints to be done in a manner to shed water.</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.06.05	<p>For all inspection covers and hatches on equipment, pump casing, valve bodies and flanges (100 mm and above), insulation shall be applied so as to facilitate removal without minimum damage to the insulation by encasing the insulation in 24 gauge GI box or 22 gauge Aluminium sheet metal boxes which are bolted together around the equipment. However continuity of the vapour seal between the static and removable portions of the insulation is to be maintained.</p>			
6.06.06	<p><b>ACOUSTIC INSULATION</b></p> <p>a) All ducts up to a distance of 5 meters from AHU shall be acoustically lined from inside with 25 mm thick resin bonded glass wool of 48 Kg/Cu.M. density and 30 gauge perforated aluminium sheet having 5 mm dia perforation at 8 to 10 mm centre-to-centre distance. Insulation shall be fixed on wooden frame of 600 x 600 mm dimension.</p> <p>b) Fibre glass tissue sheet shall be applied over the outer surface of insulation before applying perforated aluminium sheet. Application of acoustic insulation shall be inline with the requirements specified above.</p>			
7.00.00	<p><b>PLANT CONTROL</b></p>			
7.01.00	<p>Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from employer. The descriptions in the sub-sections of the control &amp; instrument sections shall also be referred to.</p>			
7.02.00	<p><b>Control Scheme for Air-Conditioning System</b></p>			
7.02.01	<p>Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of air conditioning and ventilation system as per manufacturer's standard practice. Control and monitoring of air conditioning and ventilation system from FGD control system is also acceptable.</p>			
7.03.00	<p><b>Air Handling Unit</b></p> <p>a) Humidity sensor and gysterstat located in the return air duct shall actuate the PAN humidifier to obtain the desired degree of humidification.</p> <p>b) Humidity and temp. sensor shall be provided and interlocked in steps with winter heater / re-heater / strip heaters for monsoon and winter re-heating or heating as the case may be.</p> <p>c) Heater banks shall be interlocked with the running of AHU, temperature of return air, humidity of return air and safety thermostat (airstat - located in front of the each heater in the supply air duct)</p> <p>d) AHU shall be started either locally or from the main control room of AC system by means of Remote / Manual selection facility.</p> <p>e) The closure of fire dampers, automatic tripping of AHU fans and fresh air fans shall be interlocked with Fire Detection System.</p>			
7.05.00	<p><b>Cassette /Hi-wall Split Air Conditioners</b></p> <p>Control and interlocks for these type of units shall be as per manufacturer's standard practice.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>		<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB SECTION-I-M2 AIR CONDITIONING &amp; VENTILATION SYSTEM</p>	<p>Page 19 of 26</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.06.00	<p><b>Miscellaneous Control Requirements</b></p> <p>a) The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally.</p> <p>b) Relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall made be available in FGD control system.</p>			
8.00.00	<p><b>PAINTING:</b></p>			
8.01.00	<p>All the Equipments shall be protected against external corrosion by providing suitable painting.</p>			
8.02.00	<p>The surfaces of stainless steel, Galvanized steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The Contractor shall clean the external surfaces and internal surfaces before Erection by wire brushing and air blowing. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting, etc. as per the agreed procedure.</p>			
8.03.00	<p>For all the steel surfaces (external) exposed to atmosphere (outdoor installation), one(1) coat of red oxide primer of thickness 30 to 35 microns followed up with three (3) coats of synthetic enamel paint, with 25 microns as thickness of each coat, shall be applied.</p>			
8.04.00	<p>For all the steel surfaces inside the building (indoor installation), One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat shall be applied.</p>			
8.05.00	<p>For centrifugal fans - Casing shall have hot dip/ spray galvanization (<b>minimum</b> 60 micron DFT).</p>			
8.06.00	<p>However, for all parts coming in contact with acid fumes (in Battery rooms), a coat of epoxy resin based zinc phosphate primer of minimum thickness 30 to 35 microns followed up with undercoat of epoxy resin based paint pigmented with Titanium dioxide of minimum thickness of 25 microns shall be applied and a top coat consisting of one coat of epoxy paint of approved shade and colour with glossy finish of minimum thickness of 25 microns.</p>			
9.00.00	<p><b>CODES &amp; STANDARDS</b></p>			
9.01.00	<p>The design, manufacture and performance of equipment shall comply with all currently applicable statues, regulations and safety codes in the locality where the equipments are to be installed. Nothing in this specification shall be considered to relieve the bidder of this responsibility.</p>			
9.02.00	<p>Unless otherwise specified, equipment shall conform to the latest applicable Indian or IEC standard. Equipment complying with other authoritative standards such as British, USA, ASHRAE etc. will also be considered if it ensures performance equivalent or superior to Indian Standard.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>		<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB SECTION-I-M2 AIR CONDITIONING &amp; VENTILATION SYSTEM</p>	<p>Page 20 of 26</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p style="text-align: right;"><b>Annexure –I</b></p> <p style="text-align: center;"><b>GENERAL SPECIFICATION FOR HORIZONTAL PUMPS</b></p> <p>1) <b>SCOPE</b> This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.</p> <p>2) <b>CODES AND STANDARDS</b> The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.</p> <p>3) List of Applicable Standards. IS : 1520 : Horizontal Centrifugal Pumps for clear cold fresh water IS : 5120 : Technical requirements of roto dynamic special purpose pumps API : 610 : Centrifugal pumps for general refinery service. IS : 5639 : Pumps Handling Chemicals &amp; corrosion liquids IS : 5659 : Pumps for process water HIS : Hydraulic Institute Standards, USA ASTM-1-165-65 Standards Methods for Liquid Penetration Inspection. In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.</p> <p>4) <b>DESIGN REQUIREMENTS</b></p> <p>a) The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall preferably be within <math>\pm 10\%</math> of the rated design flow as indicated in data sheets.</p> <p>b) The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of about 15% more than the design head.</p>		
<p style="text-align: center;">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p style="text-align: center;">SUB SECTION-I-M2 AIR CONDITIONING &amp; VENTILATION SYSTEM</p>	<p style="text-align: center;">Page 21 of 26</p>

CLAUSE NO.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p>									
	<b>Annexure –I</b>									
c)	Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.									
d)	<p>Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;">Speed</th> <th style="width: 40%;">Antifriction Bearing</th> <th style="width: 40%;">Sleeve Bearing</th> </tr> </thead> <tbody> <tr> <td>1500 rpm and below</td> <td>75.0 micron</td> <td>75.0 micron</td> </tr> <tr> <td>3000 rpm</td> <td>50.0 micron</td> <td>65.0 micron</td> </tr> </tbody> </table> <p>The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface.</p>	Speed	Antifriction Bearing	Sleeve Bearing	1500 rpm and below	75.0 micron	75.0 micron	3000 rpm	50.0 micron	65.0 micron
Speed	Antifriction Bearing	Sleeve Bearing								
1500 rpm and below	75.0 micron	75.0 micron								
3000 rpm	50.0 micron	65.0 micron								
e)	The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.									
f)	The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).									
g)	Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.									
h)	The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.									
5)	<b>DESIGN CONSTRUCTION</b>									
a)	Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to.									

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Annexure –I			
b)	<p><b>Pump Casing</b></p> <p>Pump casing shall have axially or radially split type construction as specified. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.</p> <p>Pump casing shall be provided with a vent connection and piping with fittings &amp; valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.</p>			
c)	<p><b>Impeller</b></p> <p>Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled.</p> <p>The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.</p>			
d)	<p><b>Impeller/Casing Wearing Rings</b></p> <p>Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.</p>			
e)	<p><b>Shaft</b></p> <p>The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.</p> <p>The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.</p>			
f)	<p><b>Shaft Sleeves</b></p> <p>Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.</p> <p>Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB SECTION-I-M2 AIR CONDITIONING &amp; VENTILATION SYSTEM</p>	<p>Page 23 of 26</p>	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<b>Annexure –I</b>			
g)	<p><b>Bearings</b></p> <p>Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished.</p> <p>The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.</p> <p>Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.</p> <p>Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.</p>			
h)	<p><b>Stuffing Boxes</b></p> <p>Stuffing box design should permit replacement of packing without removing any part other than the gland.</p> <p>Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.</p>			
i)	<p><b>Mechanical Seals</b></p> <p>Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.</p>			
j)	<p>The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.</p>			
k)	<p><b>Pump Shaft Motor Shaft Coupling</b></p> <p>The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.</p>			
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(3)-9	SUB SECTION-I-M2 AIR CONDITIONING & VENTILATION SYSTEM	Page 24 of 26	

## Annexure –I

l) **Base Plate**

A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.

m) **Assembly and Dismantling**

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

n) **Drive Motor (Prime Mover)**

The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

## ANNEXURE-II

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

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



**3X200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM  
PROJECT SPECIFIC GENERAL  
REQUIREMENTS**

**SPECIFICATION No: PE-TS-466-(571-13000-  
A)-A002**

**SECTION : I**

**SUB-SECTION : C 2B**

**REV. 00**

**SECTION: I**

**SUB-SECTION: C 2B**

**PERFORMANCE GUARANTEE TEST**

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
5.00.00	<p><b>AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT</b></p> <p>The unit auxiliary power consumption shall be calculated using the following relationship.</p> $P_a = (P_{a1} + P_{a2} + \dots + P_{an})/n$ $P_{an} = P_{un} + T_{Ln}$ <p><math>P_a</math> = Guaranteed Auxiliary Power Consumption</p> <p><math>P_{an}</math> = Auxiliary Power Consumption for unit # n</p> <p>(Where “n” is the unit number e.g. 1, 2, .....)</p>			
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p>SUB-SECTION-VI FUNCTIONAL GUARANTEES &amp; LIQUIDATED DAMAGES</p>	<p>PAGE 25 OF 30</p>	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<p> <math>P_{un}</math> = Power consumed by the auxiliaries of the unit under test  <math>T_{Ln}</math> = Losses of the transformers supplied by bidder based on works test reports </p> <p> While guaranteeing the auxiliary power consumption of each project the bidder shall necessarily include all continuously operating auxiliaries under this package. The auxiliaries to be considered shall include but not be limited to the following: </p>			
<p align="center"> <b>LOT-3 PROJECTS</b>  <b>FLUE GAS DESULPHURISATION (FGD) SYSTEM</b>  <b>PACKAGE</b> </p>	<p align="center"> <b>TECHNICAL SPECIFICATION</b>  <b>SECTION – VI, PART-A</b>  <b>BID DOC. NO.:CS-0011-109(3)-9</b> </p>	<p align="center"> <b>SUB-SECTION-VI</b>  <b>FUNCTIONAL</b>  <b>GUARANTEES &amp;</b>  <b>LIQUIDATED DAMAGES</b> </p>	<p align="center"> <b>PAGE 26 OF 30</b> </p>	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES		
	<div style="text-align: right;">  </div> <p>xxi. Air Conditioning System (*)</p> <p>Total Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of FGD Control Room Building divided by total nos. of units in respective project</p> <p>xxii Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)</p> <p>((*) Above guaranteed power consumption values shall be at 20 deg C for centrifugal fans of AHUs and at 30 deg C for centrifugal fans of UAF units and at an elevation of RL (referring to GLP of respective projects) for both AHUs and UAF centrifugal fans.)</p>		
<p style="text-align: center;">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p style="text-align: center;">SUB-SECTION-VI FUNCTIONAL GUARANTEES &amp; LIQUIDATED DAMAGES</p>	<p style="text-align: center;">PAGE 27 OF 30</p>

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	<p>(xiii) <b>Air Conditioning System</b></p> <p><b>A. Following shall be demonstrated at Shop</b></p> <p>1) Capacity and static pressure of AHU fans at its rated duty point.</p> <p><b>B. Following shall be demonstrated at Site</b></p> <p>1) Capacity (TR) of air cooled condensing units (D-X type) for A/C system of FGD control room building.</p> <p>2) Guaranteed room conditions during summer for all the Air conditioned areas.</p> <p>3) Vibration and noise level of condensing units &amp; centrifugal fans of AHUs.</p> <p>(xiv) <b>Ventilation System</b></p> <p><b>A. Following shall be demonstrated at Shop</b></p> <p>1) Capacity and discharge pressure of pumps of UAF units at its rated duty point of Ventilation system.</p> <p>2) Capacity and static pressure of UAF fans at its rated duty point of Ventilation system.</p> <p><b>B. Following shall be demonstrated at Site</b></p> <p>1) Vibration &amp; Noise level of centrifugal fans &amp; pumps of UAF units.</p>			
<p>LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9</p>	<p>SUB-SECTION-VI FUNCTIONAL GUARANTEES &amp; LIQUIDATED DAMAGES</p>	<p>PAGE 15 OF 27</p>	

<p>CLAUSE NO.</p>	<p align="center"><b>FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES</b></p> 		
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(3)-9</p>	<p align="center">SUB-SECTION-VI FUNCTIONAL GUARANTEES &amp; LIQUIDATED DAMAGES</p>	<p align="center">PAGE 28 OF 30</p>

**NOTE:**

1. The equipment's listed above for calculating auxiliary power consumption are indicative. Any other equipment required for continuous operation of the system shall also be considered for calculation of auxiliary power consumption. Power consumption of all equipments provided on unitized basis shall be included in the unit auxiliary power consumption. For common station auxiliaries, the power consumption shall be assigned to each unit based on unit load for the purpose of calculating the unit auxiliary power consumption.
2. The bidder shall furnish a list of equipments to be covered under auxiliary power consumption, which shall be subject to Employer's approval.
3. Transformer losses (TL) shall be considered as per following (as applicable)-  
Aux/LT Outdoor/ LT Indoor Transformer: 100 % No load loss and 25 % of Copper Losses.
4. Auxiliary power shall be measured without SCR (De-NOx) system.
5. Auxiliary power shall be measured at the switchgear of the drives.

**SUB-SECTION-V-QM4**

**AIR CONDITIONING & VENTILATION SYSTEM**

**AIR CONDITIONING AND VENTILATION SYSTEM FOR FGDS**

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

4.05.01	All pumps shall be tested in the manufacturer's works preferably with contract motor for capacity, efficiency, head and brake horse power. Pump shall be given running test over the entire operating range covering from the shut-off head to the maximum flow. The duration of test shall be minimum one (1) hr. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standard (HIS) and/or as per applicable Indian Standard or equivalent. Acceptance norms shall be as per approved datasheet & HIS standard only.
4.05.02	Noise and vibration shall be measured at shop for reference purpose only.
4.05.03	Pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and/or excessive vibration are observed during the shop test.
4.05.04	NPSH test shall be conducted with water as the medium, if required as per approved data sheets.
5.00.00	<b>LOW PRESSURE AIR DISTRIBUTION SYSTEM</b>
5.01.00	Functional test for fire damper along with solenoid shall be done.
5.02.00	Prototype tests report of fire damper (duly approved/accepted by ENGG) for each type and size as per UL-555 for fire rating shall be furnished.
5.03.00	Site Test- After completion, all ducting system shall be checked/tested for air leakages/tightness (smoke test) at site.
6.00.00	<b>INSULATION</b>
6.01.00	Insulation material shall be tested for all mandatory tests only as per relevant code/standard.
6.02.00	Thermal conductivity tests (for thermal insulation only) shall be done as per relevant code for the same density and thickness of material and validity of test shall be as per relevant standard.
7.00.00	<b>AIR FILTERS</b>
7.01.00	Pre/Fine filters shall be tested for initial and final pressure drop Vs flow and average synthetic dust weight arrestance as per the requirement of BS 6540/ASHARE-52-76/EN779. HEPA (Absolute) filters shall be tested as per applicable code.
8.00.00	<b>PIPES &amp; FITTINGS</b>
8.01.00	All pipes and fittings shall be tested as per applicable codes / standard.
8.02.00	Site test- Pipes shall be tested at site hydraulically/pneumatically as per application requirement
9.00.00	<b>VALVES &amp; SPECIALTIES</b>
9.01.00	Visual and dimensional check of valves as per relevant codes and approved drawing.
9.02.00	All the water line valves shall be hydraulically tested for body, seat and back seat (wherever provided) as per the relevant standard to which these valves are supplied irrespective of the working pressure for which these valves are selected. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.

9.03.00	Valves shall be offered for hydro test and pneumatic test in unpainted condition.
9.04.00	Functional check of the valves for smooth opening and closing shall be done.
10.00.00	<b>SPLIT/CASSETTE / WINDOW AC/ PAC</b>
10.01.00	Split/Cassette/ Window AC will be accepted on the basis of Manufacturer Standard Guarantee and Warrantee certificate.
10.02.00	PAC Each Unit shall be subjected to production routine Test excluding performance test carried out as per relevant standard.
10.03.00	Performance test of PAC shall be carried out as per relevant standard on one unit of each type and rating at site.
11.00.00	<b>Unitary Air Filter (UAF)</b>
11.01.00	Random 10% DPT on weld joints shall be carried out
11.02.00	Hydraulic test of pressure parts at 1.5 times the design. Pressure and water fill test of tanks shall be carried out
11.03.00	Trial assembly of Air washer/UAF for one of each size shall be done in shop.

**SUB-SECTION-V-QM4**

**AIR CONDITIONING & VENTILATION SYSTEM**

**AIR CONDITIONING AND VENTILATION SYSTEM FOR FGDS**

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

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

CLAUSE NO.	QUALITY ASSURANCE			
9.03.00	Valves shall be offered for hydro test and pneumatic test in unpainted condition.			
9.04.00	Functional check of the valves for smooth opening and closing shall be done.			
10.00.00	<b>SPLIT/CASSETTE / WINDOW AC/ PAC</b>			
10.01.00	Split/Cassette/ Window AC will be accepted on the basis of Manufacturer Standard Guarantee and Warrantee certificate.			
10.02.00	PAC Each Unit shall be subjected to production routine Test excluding performance test carried out as per relevant standard.			
10.03.00	Performance test of PAC shall be carried out as per relevant standard on one unit of each type and rating at site.			
11.00.00	<b>Unitary Air Filter (UAF)</b>			
11.01.00	Random 10% DPT on weld joints shall be carried out			
11.02.00	Hydraulic test of pressure parts at 1.5 times the design. Pressure and water fill test of tanks shall be carried out			
11.03.00	Trial assembly of Air washer/UAF for one of each size shall be done in shop.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-0011-109(1A)-2	SUB-SECTION -V- QM4 AIR CONDITIONING & VENTILATION SYSTEM	Page 3 of 3



**3X200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM  
PAINTING SPECIFICATIONS**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : I**

**SUB-SECTION : C 2C**

**REV. 00**

**SECTION: I**

**SUB-SECTION: C 2C**

**FOR PAINTING DETAILS REFER SECTION C2-A**



**3X200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM  
TECHNICAL SPECIFICATION  
(ELECTRICAL PORTION)**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : I**

**SUB-SECTION : C-3**

**REV. 00**

**SECTION: I**

**SUB-SECTION: C-3**

**TECHNICAL SPECIFICATION (ELECTRICAL PORTION)**

**KORBA STPP STAGE- I, II & III  
(3X200MW + 3X500MW + 1X500MW)**

**TECHNICAL SPECIFICATION**

**AC & VENTILATION SYSTEM  
(ELECTRICAL PORTION)**



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



**ELECTRICAL EQUIPMENT SPECIFICATION  
FOR  
AC & VENTILATION SYSTEM  
KORBA STPP, STAGE- I, II & III**

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION: **I**

REV NO. : **00** DATE: 30.07.2020

SHEET: 1 OF 1

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II	STANDARD SPECIFICATION FOR LV MOTORS	5
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The requirements mentioned in Section-I shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-II.



LE :  
**ELECTRICAL EQUIPMENT SPECIFICATION  
FOR  
AC & VENTILATION SYSTEM  
KORBA STPP, STAGE- I, II & III**

SPECIFICATION NO.
VOLUME NO. : <b>II-B</b>
SECTION : <b>I</b>
REV NO. : <b>00</b> DATE : 30.07.2020
SHEET : 1 OF 3

**TECHNICAL SPECIFICATION  
FOR  
AC & VENTILATION SYSTEM  
(ELECTRICAL PORTION)**



TITLE :  
**ELECTRICAL EQUIPMENT SPECIFICATION  
FOR  
AC & VENTILATION SYSTEM  
KORBA STPP, STAGE- I, II & III**

SPECIFICATION NO.
VOLUME NO. : <b>II-B</b>
SECTION : <b>I</b>
REV NO. : <b>00</b> DATE : 30.07.2020
SHEET : 2 OF 3

**1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for AC & VENTILATION SYSTEM (all AC & DC loads at different voltage levels like 415V AC, 240 V AC, 220 V DC etc).
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

Refer “Electrical Scope between BHEL and Vendor”.

**3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.



3 :  
**ELECTRICAL EQUIPMENT SPECIFICATION  
FOR  
AC & VENTILATION SYSTEM  
KORBA STPP, STAGE- I, II & III**

SPECIFICATION NO.
VOLUME NO. : <b>II-B</b>
SECTION : <b>I</b>
REV NO. : <b>00</b> DATE : 30.07.2020
SHEET : 3 OF 3

**4.0 List of enclosures :**

- a) Electrical scope between BHEL & vendor
- b) Customer (NTPC) specification for Motors
- c) Customer ( NTPC) cabling spec ( to be referred by vendor for their scope of work as per Electrical scope between BHEL & vendor).
- d) Quality plan for motors & NTPC quality plan
- e) Datasheet A and C for LT Motors (Annexure-I)
- f) Electrical Load data format (Annexure –II)
- g) BHEL cable listing format (Annexure –III)
- h) Typical details for Cable Tray and Accessories (Annexure-IV)

## ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

## PACKAGES : AC &amp; VENTILATION SYSTEM

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

## PROJECT: KORBA STPP STAGE- I, II &amp; III

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

## ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

## PACKAGES : AC &amp; VENTILATION SYSTEM

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

## PROJECT: KORBA STPP STAGE- I, II &amp; III

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

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.





**Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.**

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT\_CAB\_SCH\_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
  - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
  - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
  - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
  - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
  - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
  - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
  - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V  
 (dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

- B = 6.6KV (Power cables)
- C = 3.3KV (Power cables)
- D = 1.1KV (LV & DC system power & control cables)
- E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

- A = Armoured FRLS
- B = Armoured Non-FRLS
- C = unarmoured FRLS
- D = Unarmoured Non-FRLS

PVC Aluminium

- E = Armoured FRLS
- F = Armoured Non-FRLS
- G = unarmoured FRLS
- H = Unarmoured Non-FRLS

XLPE Copper

- J = Armoured FRLS
- K = Armoured Non-FRLS
- L = unarmoured FRLS
- M = Unarmoured Non-FRLS

XLPE Aluminium

- N = Armoured FRLS
- P = Armoured Non-FRLS
- Q = unarmoured FRLS
- R = Unarmoured Non-FRLS

- S = FIRE SURVIVAL CABLES
- T = TOUGH RUBBER SHEATH
- U = OVERALL SCREENED
- V = PAIRED OVERALL SCREENED
- W = PAIRED INDIVIDUAL SCREENED
- Y = COMPENSATING CABLES
- I = PRE-FABRICATED CABLES
- Z = JELLY FILLED CABLES

**SUB-SECTION-II-E2**

**MOTORS**

**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



**TECHNICAL REQUIREMENTS**



6.01.01	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.
6.01.02	For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
6.02.00	<b>Torque Requirements</b>
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor rated torque.
6.02.02	Pull out torque at rated voltage shall not be less than 205% of rated torque. It shall be 275% for crane duty motors.
6.03.00	<b>Starting voltage requirement</b>
	(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
<b>7.00.00</b>	<b>DESIGN AND CONSTRUCTIONAL FEATURES</b>
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 (CACCA) 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

**TECHNICAL REQUIREMENTS**



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

**TECHNICAL REQUIREMENTS**



	<p>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.</p> <p>7.11.00 The spacing between gland plate &amp; centre of bottom terminal stud shall be as per Table-I.</p> <p>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.</p> <p>7.13.00 The motors shall be suitable for bus transfer schemes provided on the 11kV, 6.6 KV, 3.3 kV /415V systems without any injurious effect on its life.</p> <p>7.14.00 For motors rated 2000 KW &amp; above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.</p> <p>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.</p> <p>8.00.00 The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance):</p> <p>(a) From 50KW &amp; upto 110KW : 11.0</p> <p>(b) From 110 KW &amp; upto 200 KW : 9.0</p> <p>(c) Above 200 KW &amp; upto 1000KW : 10.0</p> <p>(d) From 1001KW &amp; upto 4000KW : 9.0</p> <p>(e) Above 4000KW : 6 to 6.5</p> <p><b>10.00.00 TYPE TEST</b></p> <p><b>10.01.00 HT MOTORS</b></p> <p>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.</p> <p>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</p>
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<p>10.01.06</p>	<p><b>LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED</b></p> <p>The following type test reports shall be submitted for each type and rating of HT motor</p> <ul style="list-style-type: none"> <li>(a) Degree of protection test for the enclosure followed by IR, HV and no load run test.</li> <li>(b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.</li> <li>(c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15</li> <li>(d) Surge-withstand test on inter-turn insulation shall be as per clause no. 4.2 of IEC 60034, part-15</li> </ul>
<p>10.02.00</p>	<p><b>LT Motors</b></p>
<p>10.02.01</p>	<p>LT Motors supplied shall be of type tested design. During detailed engineering, the Contactor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last <i>ten</i> years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.</p>
<p>10.02.02</p>	<p>However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.</p>
<p>10.02.03</p>	<p><b>LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED</b></p> <p><b>The following type test reports shall be submitted for each type and rating of LT motor of above 100 KW only</b></p> <ul style="list-style-type: none"> <li>1. Measurement of resistance of windings of stator and wound rotor.</li> <li>2. No load test at rated voltage to determine input current power and speed</li> <li>3. Open circuit voltage ratio of wound rotor motors ( in case of Slip ring motors)</li> <li>4. Full load test to determine efficiency power factor and slip</li> <li>5. Temperature rise test</li> </ul>

**TECHNICAL REQUIREMENTS**

6. Momentary excess torque test.
7. High voltage test
8. Test for vibration severity of motor.
9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section)
10. Test for degree of protection and
11. Overspeed test.
12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

10.03.00 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

10.04.00 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

TABLE - I

**DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS**

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

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

**PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:**

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

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



LE

**LV MOTORS****DATA SHEET-A**

KORBA STPP, STAGE-I, II &amp; III

SPECIFICATION NO.

VOLUME II B

SECTION D

REV. NO. 00 DATE: 30.07.2020

SHEET 1 OF 1

**ANNEXURE-I**

- 1.0 Design ambient temperature : 50 °C
- 2.0 Maximum acceptable kW rating of LV motor : 200KW \*
- 3.0 Installation (Indoors/ Outdoors) : As required
- 4.0 Details of supply system
- a) Rated voltage (with variation) : 415V ± 10%
  - b) Rated frequency (with variation) : 50 Hz + 3 % to - 5%
  - c) Combined voltage & freq. variation : 10% (sum of absolute values)
  - d) System fault level at rated voltage : 50 kA for 1 sec
  - e) Short time rating for terminal boxes
    - o 110 kW and above (Breaker : 50 KA for 0.25 sec. Controlled)
    - o Below 110 kW (Contactor : 50 KA protected by HRC fuse Controlled)
  - f) LV System grounding : Solidly
- 5.0 Winding & Insulation : Class F with temp rise limited to class B
- 6.0 Minimum voltage for starting (As percentage of rated voltage) : 85% for motor ratings below 110kW  
80% for motor ratings from 110kW to 200kW.
- 7.0 Power cables data : Shall be given during detailed engg.
- 8.0 Earth Conductor Size & Material : Shall be given during detailed engg.
- 9.0 Space heater supply (for motors >=30kw) : 240 V, 1φ, 50 Hz
- 10.0 Rating up to which Single phase motor : Acceptable below 0.2 kW
- 11.0 Locked rotor current
- a) Limit as percentage of FLC : As per IS 12615
- 12.0 Makes : BHEL/ Customer approval (Package owner to take care)
- 13.0 Paint shade : Blue (RAL 5012) – Corrosion proof
- 14.0 Degree Of protection for motor/ terminal box : Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-
- i) Indoor motors - IP 54
  - ii) Outdoor motors - IP 55
  - iii) Cable box-indoor area - IP 54
  - iv) Cable Box-Outdoor area - IP 55

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

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

**DATA SHEET – C**

<b>CLAUSE NO.</b>	<b>Bidder's Name .....</b>			
	<b>DE-1B</b>	<b>LT MOTORS</b>		
	<b>A.</b>	<b>GENERAL</b>		
	5.	Manufacturer & Country of origin. (Shall be as per approved QA make)		
	6.	Equipment driven by motor		
	7.	Motor type		
	8.	Quantity		
	<b>B.</b>	<b>DESIGN AND PERFORMANCE DATA</b>		
	18.	Frame size		
	19.	Type of duty		
	20.	Type of enclosure /Method of cooling/ Degree of		
	21.	Applicable standard to which motor generally		
	22.	Efficiency class as per IS 12615		
	23.	(a)Whether motor is flame proof	Yes/No	
		(b)If yes, the gas group to which it conforms as per IS:2148		
	24.	Type of mounting		
	25.	Direction of rotation as viewed from DE END		
	26.	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)		
	27.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)		
	28.	Maximum continuous load demand of driven		
	29.	Rated Voltage (volts)		
	30.	Permissible variation of :		
		a. Voltage (Volts)		
		b. Frequency (Hz)		
		c. Combined voltage and frequency		
	31.	Rated speed at rated voltage and		
	32.	At rated Voltage and frequency:		
		a. Full load current		
	<b>LOT 3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		<b>ATTACHMENT-12 TO SECTION-VII TECHNICAL DATA SHEETS BID DOC. NO.: CS-00111-109(3)-9</b>	<b>PART-F CHAPTER-II MODULE-II SUB-SECTION:DE1 MOTORS</b>
				PAGE 13 OF 17

CLAUSE NO.

Bidder's Name .....



	b. No load current	
33.	Power Factor at	
	a. 100% load	
	b. NO load	
	c. Starting.	
34.	Efficiency at rated voltage and frequency,	
	a. 100% load	
	b. 75% load	
	c. 50% load	
35.	Starting current (amps) at	
	a. 100 % voltage	
	b. 85% voltage	
	c. 80% voltage	
36.	Minimum permissible starting Voltage (Volts)	
37.	Starting time with minimum permissible voltage	
	a. Without driven equipment coupled	
	b. With driven equipment coupled	
38.	Safe stall time with 100% and 110% of rated	
	a. From hot condition	
	b. From cold condition	
39.	Torques :	
	a. Starting torque at min. permissible voltage(kg-	
	b. Pull up torque at rated voltage.	
	c. Pull out torque	
	d. Min accelerating torque (kg.m) available	
	e. Rated torque (kg.m)	
40.	Stator winding resistance per phase (ohms at 20	
41.	GD <sup>2</sup> value of motors	

<b>CLAUSE NO.</b>	<b>Bidder's Name .....</b>		
	42.	No of permissible successive starts when motor is in hot condition	
	43.	Locked Rotor KVA Input	
	44.	Locked Rotor KVA/KW	
	45.	Vibration limit :Velocity (mm/s)	
	46.	Noise level limit (dBA)	
	<b>C.</b>	<b>CONSTRUCTIONAL FEATURES</b>	
	1.	Stator winding insulation	
		a. Class & Type	
		b. Winding Insulation Process	
		c. Tropicalised (Yes/No)	
		d. Temperature rise over specified maximum ambient temperature of 50 deg C	
		e. Method of temperature measurement	
		f. Stator winding connection	
	2.	Main Terminal Box	
		a. Type	
		b. Location(viewed from NDE side)	
		c. Entry of cables(bottom/side)	
		d. Recommended cable size(To be matched with cable size envisaged by owner)	
		e. Fault level (MVA),Fault level duration(sec)	
		f. Cable glands & lugs details (shall be suitable for	
	3.	Type of DE/NDE Bearing	
	4.	Motor Paint shade	
	5.	Weight of	
		a. Motor stator (KG)	
		b. Motor Rotor (KG)	
		c. Total weight (KG)	
LOT 3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	ATTACHMENT-12 TO SECTION-VII TECHNICAL DATA SHEETS BID DOC. NO.: CS-00111-109(3)-9		PART-F CHAPTER-II MODULE-II SUB-SECTION:DE1 MOTORS
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<b>CLAUSE NO.</b>	<b>Bidder's Name .....</b>				
	<b>D.</b>	<b>List of accessories.</b>			
	1.	3	Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)		
	2.		Terminal Box for Space Heater (Yes/No)		
	3.		Speed switch (Yes/No)		
	4.		Insulation of bearing (Yes/No)		
	5.		Noise reducer(Yes/No)		
	6.		Grounding pads		
			i) No and size on motor body		
			ii) Nos on terminal Box		
	7.		Vibration pads		
			i) Nos and size		
			ii) Location		
	8.		Any other fitments		
	<b>E.</b>	<b>List of curves.</b>			
	1.		Torque speed characteristic of the motor		
	2.		Thermal withstand characteristic		
	3.		Starting. current Vs. Time		
	4.		Starting. current Vs speed		
	5.		P.F. and Effi. Vs Load		
	<b>F.</b>	<b>Additional Data to be filled for each rating of DC Motor</b>			
	1.		Rated armature voltage (Volt)		
	2.		Rated field excitation (Amp)		
	3.		Permissible % variation in voltage		
	4.		Minimum Permissible Starting voltage (volt)		
	5.		At rated voltage		
			i)Full load Armature current.(Amp)		
	<b>LOT 3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		<b>ATTACHMENT-12 TO SECTION-VII TECHNICAL DATA SHEETS BID DOC. NO.: CS-00111-109(3)-9</b>	<b>PART-F CHAPTER-II MODULE-II SUB-SECTION:DE1 MOTORS</b>	<b>PAGE 16 OF 17</b>

CLAUSE NO.	Bidder's Name .....		
		ii) Full load Field current (Amp)	
		iii) No load Armature current (Amp)	
	6.	Full load Field current (Amp)	
	7.	No load Armature current (Amp)	
	8.	Minimum permissible field current (Amp) to avoid	
		i) Maximum permissible voltage	
		ii) Rated voltage	
		iii) Minimum Permissible Voltage	
	9.	Resistance (indicative Values) in ohm	
		i) Armature winding (Arm + IP + Series) at 25	
		ii) Field Winding at 25 deg. C	
	10..	Inductance (indicative values)	
		i) Armature winding	
		ii) Field winding	
	11	Value of trimmer resistance (ohm) to be connected in series with the shunt field to	
		i) 220 V DC	
		ii) 250 V DC	
		iii) 187 V DC	
	12	Value of the external resistance (ohm) required to be connected in series with armature during starting only	
	13	Technical data sheet for external resistance box	
	14	GA drawing of motor	
	15	Starting time calculation	
	16	Starter resistance design calculation	
	17	Electrical connection diagram of motor	
<b>LOT 3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>ATTACHMENT-12 TO SECTION-VII TECHNICAL DATA SHEETS BID DOC. NO.: CS-00111-109(3)-9</b>	<b>PART-F CHAPTER-II MODULE-II SUB-SECTION: DE1 MOTORS</b>	<b>PAGE 17 OF 17</b>



FILE :  
**GENERAL TECHNICAL REQUIREMENTS**

**FOR**  
**LV MOTORS**

SPECIFICATION NO.  
PE-SS-999-506-E101

VOLUME NO. : **II-B**

SECTION : **D**

REV NO. : **00** DATE : 29/08/2005

SHEET : 1 OF 1

## **GENERAL TECHNICAL REQUIREMENTS**

**FOR**

**LV MOTORS**

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



GENERAL TECHNICAL REQUIREMENTS  
FOR  
LV MOTORS

SPECIFICATION NO. PE-SS-999-506-E101
VOLUME NO. : II-B
SECTION : D
REV NO. : 00 DATE : 29/08/2005
SHEET : 1 OF 4

**1.0 INTENT OF SPECIFICATION**

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

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

**2.0 CODES AND STANDARDS**

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

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

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

**3.0 DESIGN REQUIREMENTS**

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

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

**3.3 Starting Requirements**

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

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



TITLE :

**GENERAL TECHNICAL REQUIREMENTS****FOR****LV MOTORS**

SPECIFICATION NO.

PE-SS-999-506-E101

VOLUME NO. : **II-B**SECTION : **D**REV NO. : **00** DATE : 29/08/2005

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The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

- i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)
- iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor

### 3.4 Running Requirements

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

### 3.5 Stress During bus Transfer

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

### 4.0 CONSTRUCTIONAL FEATURES

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.



GENERAL TECHNICAL REQUIREMENTS  
FOR  
LV MOTORS

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



LE :  
**GENERAL TECHNICAL REQUIREMENTS**  
  
**FOR**  
  
**LV MOTORS**

SPECIFICATION NO. PE-SS-999-506-E101
VOLUME NO. : <b>II-B</b>
SECTION : <b>D</b>
REV NO. : <b>00</b> DATE : 29/08/2005
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- 4.9.1 Motors provided for similar drives shall be interchangeable.
- 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.
- 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.
- 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.
- 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.
- 4.9.6 Name plate with all particulars as per IS: 325 shall be provided
- 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

**5.0 INSPECTION AND TESTING**

- 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.
- 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.
- 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.
- 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

**6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT**

- a) OGA drawing showing the position of terminal boxes, earthing connections etc.
- b) Arrangement drawing of terminal boxes.
- c) Characteristic curves:  
*(To be given for motor above 55 kW unless otherwise specified in Data Sheet).*
- i) Current vs. time at rated voltage and minimum starting voltage.
- ii) Speed vs. time at rated voltage and minimum starting voltage.
- iii) Torque vs. speed at rated voltage and minimum voltage.  
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
- iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

**SUB-SECTION-V-QE1**

**MOTORS**



MOTOR

TESTS/CHECKS TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating Physical Inspection	/General Mech/Chem. Properties	NDT /DP/MP/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034/IEC 60079-I/ IS-12615	Vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y										
Shaft	Y	Y	Y	Y	Y	Y			Y										
Magnetic Material	Y	Y	Y	Y			Y			Y		Y							
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y			Y							
Stator copper	Y	Y	Y	Y			Y		Y			Y							
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y										
Insulating Material	Y		Y	Y			Y					Y							
Tubes, for Cooler	Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y											
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y											
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y										

CLAUSE NO.

QUALITY ASSURANCE



Wound stator	Y	Y					Y	Y											
Wound Exciter	Y	Y					Y	Y											
Rotor complete	Y	Y					Y						Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y												
Accessories, RTD, BTD, CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y																
Complete Motor	Y	Y	Y												Y	Y	Y	Y1	Y

**Note:** 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor upto 50KW.  
 2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard  
 3. Makes of major bought out items for HT motors will be subject to NTPC approval.  
 4. Y1 = for HT Motor / Machines only.



MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS

STANDARD QUALITY PLAN

SPEC. NO :

CUSTOMER :

QP NO.: PED-506-00-Q-006, REV-02

DATE:27.02.2020

PROJECT:

PO NO.:

ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))

SYSTEM:

SECTION: II

SHEET 1 OF 2

SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
					M	C/N			9	D	M	C	N	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	-DO-	P	-	-		
		2.DIMENSIONS	MA	-DO-	-DO-	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	P	-	-		
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	-DO-	P	-	-		
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	SAME AS COL.7	LOG BOOK	P	-	-		
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	-DO-	100%	100%	IS-325 / IS-12615/ APPROVED DATA SHEET	SAME AS COL.7	TEST/ INSPN. REPORT	P	W	W		NOTE -1 & NOTE-2
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET	TEST/ INSPN. REPORT	P	W	W		NOTE -1 & NOTE-2

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Reviewed by:	<i>[Signature]</i>	P. Dutta	Reviewed by:		

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02/03/2020



	<b>MANUFACTURER/ BIDDER/ SUPPLIER NAME &amp; ADDRESS</b>	<b>STANDARD QUALITY PLAN</b>			<b>SPEC. NO. :</b>		
		CUSTOMER :			QP NO.: PED-508-00-Q-007, REV-04		DATE: 27.02.2020
		PROJECT:			PO NO.:		
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))		SYSTEM:	SECTION: II		SHEET 1 OF 9

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

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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :		
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04		DATE: 27.02.2020
		PROJECT:		PO NO.:		
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))		SYSTEM:		SECTION: II

SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
					6	7			9	10	11	12	13	14
15	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	-DO-		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG / SPEC.	MANUFACTURER'S DRG / STD.	SUPPLIER'S TC		PV	-	-	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	-DO-	MANUFACTURER'S DRG.	LOG BOOK		PV	-	-	
		4. INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	100%	ASTM-A388	MANUFACTURER'S STD.	-DO-	✓	PW	V	-	FOR DIA OF 55 MM & ABOVE
16	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	-DO-		PV	-	-	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-		PV	-	-	
		3. DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG / STD	MANUFACTURER'S DRG / STD.	-DO-		PV	-	-	
		4. PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	-DO-	-DO-	TEST REPORT		PV	-	-	

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Reviewed by:	<i>[Signature]</i>	P. Dutt	Reviewed by:		

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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO.:	DATE: 27.02.2020  SHEET 3 OF 9
		CUSTOMER:	QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
					M	C/N			D	M	C	N		
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VSUAL	100%	-	MANUFACTURER'S STD.	NO VISUAL DEFECTS	TEST REPORT	PV	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	-		MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC	PV	-	-		
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VSUAL	100%	-	MANUFACTURER'S DRG.	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	P	-	-		
		2. DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-		MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	-DC-	PV	-		-
		3. ACCEPTANCE TESTS	MA	E.ELECT. & MECH TESTS	-DO-	-		MANUFACTURER'S DRG/ STD.	MANUFACTURER'S DRG/ STD.	SUPPLIER'S TC	PV	-		-
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VSUAL	100%	-	MANUFACTURER'S DRG/ SPEC.	FREE FROM VISUAL DEFECTS	LOG BOOK	*PV	-	-		
		2. ELECT. PROP. & MECH. PROP	MA	E.ELECT. & MECH TEST	SAMPLES	-		MANUFACTURER'S DRG/ SPEC.	MANUFACTURER'S/ SPEC.	SUPPLIERS TC & VENDOR'S TEST REPORTS	PV	-	-	

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		CUSTOMER :	QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	

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

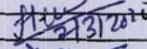
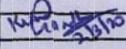
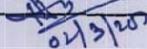
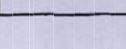
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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO.:	DATE: 27.02.2020  SHEET 5 OF 9
		CUSTOMER:	QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	

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

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Hema K.	Checked by:		KUNAL CHANDKI
Reviewed by:		P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO.:	DATE: 27.02.2020
		CUSTOMER :	QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	

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					M	C/N				D	M	C	N
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURERS STD.	LOG BOOK	P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	-DO-	-DC-	LOG BOOK	P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURERS STD./APPROVED DATASHEET	LOG BOOK	P	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-	-DO-	-DC-	LOG BOOK	P	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	100%	100%	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	LOG BOOK	✓	P	V	-
		4.RESISTANCE	CR	-DO-	100%	100%	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	LOG BOOK	✓	P	V	-
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-	-DO-	-DC-	LOG BOOK	P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFRR'S STANDARD	LOG BOOK	P	-	-	
		2.TEMP. PRESSURE VACCUUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURERS STANDARD	LOG BOOK	P	-	-	
		3.NO. OF DIPS	MA	-DO-	CONTINUOUS	CONTINUOUS	MANUFACTURER'S STANDARD	MANUFACTURERS STANDARD	LOG BOOK	✓	P	V	-

THREE DIPS TO BE GIVEN

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	<i>[Signature]</i>	Mema K.	Checked by:	<i>[Signature]</i>	<i>[Signature]</i>
Reviewed by:	<i>[Signature]</i>	P. Dutt	Reviewed by:	<i>[Signature]</i>	<i>[Signature]</i>

02/3/2020 P. Dutt

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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO.:		
		CUSTOMER :		QP NO.: PED-506-00-C-007, REV-04		DATE: 27.02.2020
		PROJECT:		PO NO.:		
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 7 OF 9	

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

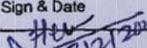
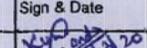
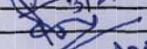
BHEL					
ENGINEERING			QUALITY		
Prepared by:	Sign & Date	Name	Checked by:	Sign & Date	Name
Reviewed by:	<i>[Signature]</i>	<i>Hema K.</i>	Reviewed by:	<i>[Signature]</i>	<i>KUNAL GANDHI</i>

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		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 8 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD	AGENCY				
					M	C/N				D	M	C	N	
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT. TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT		P	W*	W*	*NOTE - 1
		2. ROUTINE TESTS INCLUDING SPECIAL TEST	MA	-DO-	100%	100%	-DO-	-DO-	-DO-		P	VW*	VW*	*NOTE - 2
		3. VIBRATION & NOISE LEVEL	MA	-DO-	100%	100%	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	-DO-		P	VW*	VW*	*NOTE - 2
		4. OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT		P	W	-	
		5. DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/SIZE	1/TYPE/SIZE	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✓	P	V	V	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	100%	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	-DO-		P	VW*	VW*	*NOTE - 2
		7. MEASUREMENT OF RESISTANCE, R OF SPACE HEATER	MA	-DO-	100%	100%	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	-DO-		P	VW*	VW*	*NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	100%	IS-325/IS-12615& DATA SHEET	IS-325/IS-12615 & DATA SHEET	TEST/INSPC. REPORT		P	VW*	VW*	*NOTE - 2
		9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	1/TYPE	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✓	P	V	V	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC		P	WS	WS	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY *NOTE - 2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
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Reviewed by:	 03/27/2020	P. Datta	Reviewed by:		

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Sign & Date	
Seal	

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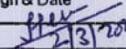
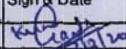
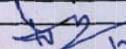
Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY				
					M	C/N			9	.	**				
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING.	AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING.	INSPC REPORT			P	W	-	IF APPLICABLE, REFER SEAWORTHY PACKING ALSO.

**NOTES:**

- 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.
- 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.
- 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.
- 4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.
- 5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.
- 6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

**LEGENDS:**

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

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Hema K.	Checked by:		KUNAL GANDHI
Reviewed by:		P. Dutt	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
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Approved by:			

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<p>Each cable vault should have at least two doors.</p> <p>Exit signs shall be provided near doors for personnel escape in case of emergency</p>	
2.01.06	<p><b>Boiler Area</b></p> <p>Cable trays in boiler &amp; ESP area shall be supported from the boiler and ESP structures. The same shall be coordinated with SG/ESP contractor.</p> <p>Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in boiler/ESP area.</p>	
2.01.07	<p>Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries.</p>	
2.01.08	<p><b>OffSite Area</b></p> <p>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.</p> <p>Cable trenches provided shall be separated from fuel oil area to avoid oil accumulation.</p>	
2.01.09	<p>The cable slits to be used for motor/equipment power/control supply shall be sand filled &amp; covered with PCC after cabling.</p>	
2.01.10	<p>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.</p>	
2.01.11	<p>Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to:</p> <ul style="list-style-type: none"> <li>• Meet all safety requirements</li> <li>• Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc</li> </ul>	
<b>3.00.00</b>	<b>EQUIPMENT DESCRIPTION</b>	
3.01.00	<b>Cable trays, Fittings &amp; Accessories</b>	
3.01.01	<p>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 &amp; control cables and perforated for instrumentation cables.</p>	
3.01.02	<p>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.</p>	
3.01.03	<p>Cable trays shall have standard width of 150 mm, 300 mm &amp; 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.</p>	
3.01.04	<p>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</p>	
<p><b>LOT-3 PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p><b>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</b></p>	<p><b>SUB SECTION-II-E6 CABLING, EARTHING &amp; LIGHTNING PROTECTION</b></p> <p>Page 3 of 23</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.01.05	<p>galvanised as per Clause No. 3.13.00 of this chapter. Troughs shall be standard width of 50 mm &amp; 75 mm with depth of 25 mm.</p> <p>The tolerance for cable tray and accessories shall be as per IS 2102 (Part-1). Tolerance Class: - Coarse</p>		
3.02.00	<p><b>Support System for Cable Trays</b></p>		
3.02.01	<p>Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings.</p>		
3.02.02	<p>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</p> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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 galvansied surface shall be brushed and red lead primer, oil primer &amp; aluminium paint shall be applied</li> <li>All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation.</li> <li>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.</li> <li>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.</li> <li>Support system shall be able to withstand <ul style="list-style-type: none"> <li>weight of the cable trays</li> <li>weight of the cables (75 Kg/Metre run of each cable tray)</li> <li>Concentrated load of 75 Kg between every support span.</li> <li>Factor of safety of minimum 1.5 shall be considered.</li> </ul> </li> </ol>		
<p>LOT-3 PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</p>	<p>SUB SECTION-II-E6 CABLING, EARTHING &amp; LIGHTNING PROTECTION</p>	<p>Page 4 of 23</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.02.03	<p>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 the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid.</p>		
3.02.04	<p>Four legged structure shall be provided wherever there is change in elevation and change in direction</p>		
3.02.05	<p>FOR COAL HANDLING PLANT/<b>FGD PLANT AREA</b> THE FOLLOWING SHALL ALSO BE APPLICABLE:</p> <p>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.</p> <p>b) Cable trenches shall be provided only in Switchgear/MCC rooms.</p> <p>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.</p> <p>d) Cables for PCS and BSS shall be routed along the conveyors through GI conduits.</p>		
3.03.00	<p><b>Pipes, Fittings &amp; Accessories</b></p>		
3.03.01	<p>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</p>		
3.03.02	<p>GI Pipes shall be of medium duty as per IS: 1239</p>		
3.03.03	<p>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.</p>		
3.03.04	<p>Hume pipes shall be NP3 type as per IS 458.</p>		
3.03.05	<p>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</p>		
3.03.06	<p>HDPE pipes and conduits shall be PE-80, PN-10 type as per IS 4984/IS 8008 part-I.</p>		
<p>LOT-3 PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</p>	<p>SUB SECTION-II-E6 CABLING, EARTHING &amp; LIGHTNING PROTECTION</p>	<p>Page 5 of 23</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.04.00	<b>Junction Boxes</b>		
3.04.01	<p>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 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:-</p> <p>(a) Impact resistance for impact energy of 2 Joules (IK07) as per BS EN50102</p> <p>(b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb.</p> <p>(c) Class of protection shall be IP 55.</p> <p>(d) HV test.</p>		
3.04.02	<p>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.</p>		
3.05.00	<b>Terminations &amp; Straight Through Joints</b>		
3.05.01	<p>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&amp;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 &amp; 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).</p>		
3.05.02	<p>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 &amp; of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV &amp; 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</p>		
<p align="center"><b>LOT-3 PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p align="center"><b>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</b></p>	<p align="center"><b>SUB SECTION-II-E6 CABLING, EARTHING &amp; LIGHTNING PROTECTION</b></p>	<p align="center">Page 6 of 23</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
<del>3.05.03</del>	<del>1.1 KV grade Straight Through Joint shall be of proven design.</del>		
3.06.00	<b>Cable glands</b>		
3.06.01	Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.		
3.07.00	<b>Cable lugs/ferrules</b>		
3.07.01	Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to IS/DIN standards.		
3.08.00	<b>Trefoil clamps</b>		
3.08.01	Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current.		
3.09.00	<b>Cable Clamps &amp; Ties</b>		
3.09.01	The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyester coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.		
<del>3.10.00</del>	<del><b>Receptacles</b></del>		
<del>3.10.01</del>	<del>Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped galvanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break, AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with RCCB/RCD of 30mA sensitivity having facility for manual testing/checking of operation of RCCB/RCD.</del>		
3.11.00	<b>Cable Drum Lifting Jack</b>		
	The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack		
<b>LOT-3 PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</b>	<b>SUB SECTION-II-E6 CABLING, EARTHING &amp; LIGHTNING PROTECTION</b>	<b>Page 7 of 23</b>

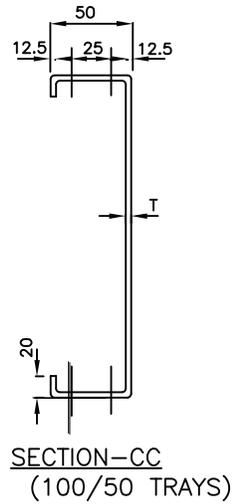
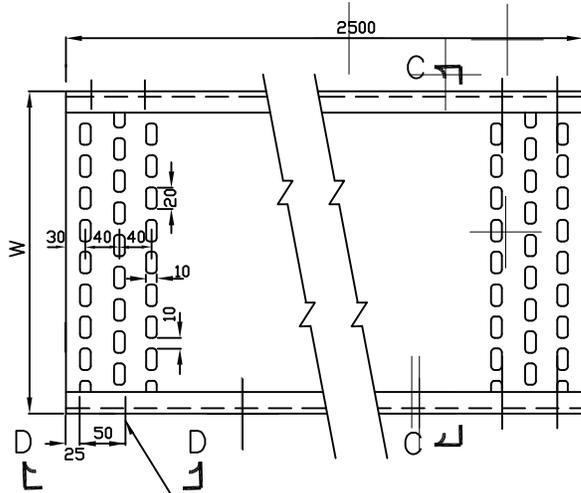
CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for NTPC use. Contractor has to make arrangements for his own jacks for cable reeling/unreeling under his scope of installation.</p>		
3.12.00	<p><b>Galvanising</b></p>		
3.12.01	<p>Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 &amp; IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.</p>		
3.12.02	<p>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</p>		
3.13.00	<p><b>Welding</b></p>		
3.13.01	<p>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</p>		
4.00.00	<p><b>INSTALLATION</b></p>		
4.01.00	<p><b>Cable tray and Support System Installation</b></p>		
4.01.01	<p>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.</p>		
4.01.02	<p>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.</p>		
4.01.03	<p>The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.</p>		
4.01.04	<p>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.</p>		
4.01.05	<p>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.</p>		
4.01.06	<p>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</p>		
<p>LOT-3 PROJECTS FLUE GAS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</p>	<p>SUB SECTION-II-E6 CABLING, EARTHING &amp; LIGHTNING PROTECTION</p>	<p>Page 8 of 23</p>

## TECHNICAL REQUIREMENTS

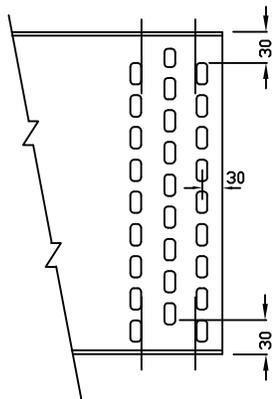


	<p>installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.</p>										
4.02.00	<b>Conduits/Pipes/Ducts Installation</b>										
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 style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Conduit /pipe size (dia).</th> <th style="text-align: left;">Spacing</th> </tr> </thead> <tbody> <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> </tbody> </table>	Conduit /pipe size (dia).	Spacing	Upto 40 mm	1 M	50 mm	2.0 M	65-85 mm	2.5 M	100 mm and above	3.0 M
Conduit /pipe size (dia).	Spacing										
Upto 40 mm	1 M										
50 mm	2.0 M										
65-85 mm	2.5 M										
100 mm and above	3.0 M										
4.02.05	For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.										
4.03.00	<b>Junction Boxes Installation</b>										
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	<b>Cable Installation</b>										
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: <ol style="list-style-type: none"> <li>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</li> </ol>										

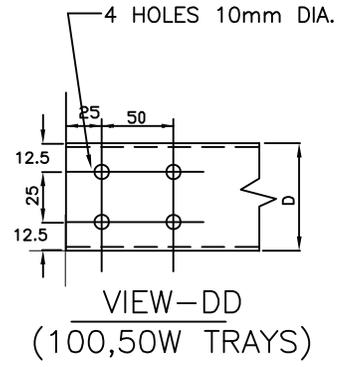
51291/2020/PS-PEM-MAX



4 HOLES 10mm DIA.



ARRANGEMENT OF PERFORATIONS



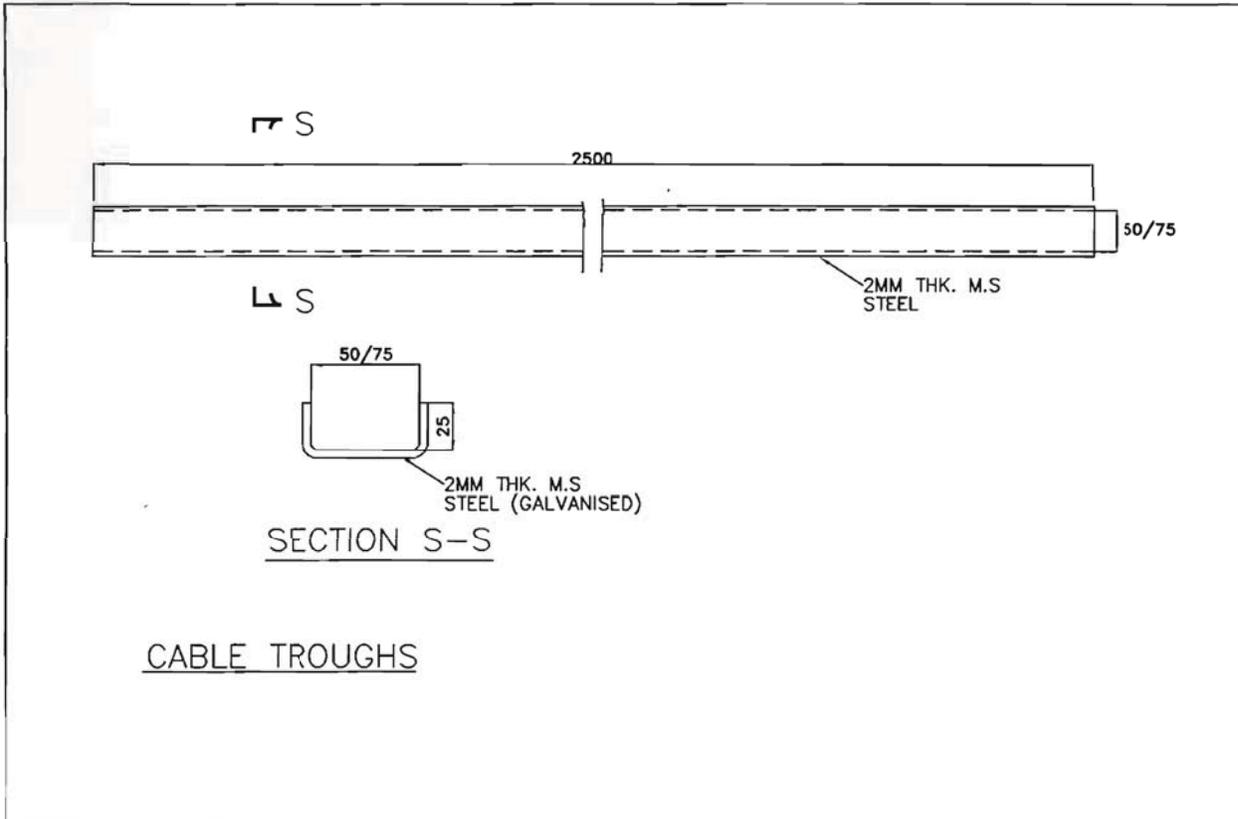
TRAY WIDTH W (mm)	100	50
TRAY DEPTH D (mm)	50	50
T (mm)	2	2

PERFORATED TYPE TRAY



TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

DWG. NO.



~~SEE GENERAL NOTES IN SHEET 11.~~



TYPICAL DETAILS OF  
CABLE TRAY AND ACCESSORIES

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

SH 10 OF 11 REV 00



**3X200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM  
TECHNICAL SPECIFICATION  
(C&I PORTION)**

**SPECIFICATION No: PE-TS-466-(571-13000-  
A)-A002**

**SECTION : I**

**SUB-SECTION : C-4**

**REV. 00**

**SECTION: I**

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

	<b>3X200 + 3X500 +1X500 MW NTPC KORBA TPP STAGE I, II &amp; III- FGD</b>	
	<b>TECHNICAL SPECIFICATION (C&amp;I) FOR HVAC SYSTEM</b>	

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

				
	<b>KORBA FGD STAGE I, II &amp; III</b>	DESG	SK	
	JOB NO: 466	CHKD	SCS	
REV. NO. 00	DATE: 24.07.2020	APPD	SCS	

**3X200 + 3X500 +1X500 MW NTPC KORBA TPP STAGE  
I, II & III- FGD**

TECHNICAL SPECIFICATION (C&I) FOR  
HVAC SYSTEM

## INDEX

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

SECTION: C  
SUB SECTION: C&I

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



## C&I SPECIFICATION FOR HVAC SYSTEM

SECTION: C  
SUB SECTION: C&I

### Specific Technical Requirements (C&I):

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



**C&I SPECIFICATION FOR  
HVAC SYSTEM**

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

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



**C&I SPECIFICATION FOR  
HVAC SYSTEM**

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



**C&I SPECIFICATION FOR  
HVAC SYSTEM**

SECTION: C  
SUB SECTION: C&I

shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder

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



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



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



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

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

**Note:-**

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



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

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



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

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

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

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

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

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	7. Mounting 8. Accessories 9. Composite Accuracy	2 inch pipe mounting with Canopy. As required by service and operating condition. (Refer note 2 ) RTD                    =<0.25% of 0-250 deg C span T/C-K type            =<0.2% of 0-600 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C  Notes: 1. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output. 2. Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed. 3. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., basic accuracy, digital accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified. All such accuracy/ temperature effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above. 3. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only. 4. Dual input temperature transmitters can also be accepted in place of single input TT.	
<b>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATIONS SECTION – VI, PART-B            BID DOC. NO.: CS-0011-109(1A)-2</b>	<b>PART-B            SUB-SECTION-III-C2            MEASURING INSTRUMENTS</b>	<b>PAGE 8 OF 8</b>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.02.00	<b>Resistance Temperature Detector ( RTD )</b>		
	<b>Sr. No.</b>	<b>Features</b>	<b>Essential/Minimum Requirements</b>
	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.
	<b>NOTES :</b>		
	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	<b>Metal Temperature Thermocouples</b>		
	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).	
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1)-2	SUB-SECTION-III-C2 MEASURING INSTRUMENTS	PAGE 9 OF 34

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

CLAUSE NO.

## TECHNICAL REQUIREMENTS



4.00.00

**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

 FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE

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

 SUB-SECTION-III-C2  
MEASURING  
INSTRUMENTS

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CLAUSE NO.	TECHNICAL REQUIREMENTS				
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.					
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	<b>PROCESS ACTUATED SWITCHES</b>			
	<b>FEATURES</b>			<b>ESSENTIAL / MINIMUM REQUIREMENTS</b>
	Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches	
Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application)	Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the application. .	
Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS	
End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard	
Over range/ proof pressure	150% of maximum operating pr.	-	150% of maximum operating pr.	
Repeatability	+/- 0.5% of full range			
No. of contacts	2 No.+2NC. SPDT snap action dry contact			
Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)			
Elect. Connection	Plug in socket.			
Set point adjustment	Provided over full range.			
Dead band adjustment	Adjustable/ fixed as per requirement of application.			
Enclosure	Weather and dust proof as per IP-55, metallic housing.			
Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories	
Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-	
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1)-2	SUB-SECTION-III-C2 MEASURING INSTRUMENTS	PAGE 14 OF 34	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Power Supply (wherever required)	As per Contractor's Standard practice.	
	<p>Notes :-</p> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.</li> <li>4) The specifications of switches for air conditioning &amp; ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.</li> </ol>		
6.00.00	<p><b>SOLENOID VALVES</b></p> <p>Solenoid valves shall fulfill the following requirements: -</p> <ol style="list-style-type: none"> <li>a) Type 2/3/4 way SS 316/ forged brass (depending on the application subject to Employer's approval during detailed engg.)</li> <li>b) Power supply 24V DC.</li> <li>c) Plug in connector connection.</li> <li>d) Insulation : Class "H"</li> </ol>		
7.00.00	<p><b>Limit switches</b></p> <ol style="list-style-type: none"> <li>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.</li> </ol>		
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

**HUMIDITY SENSOR**

Sensor : Capacitance type

Accuracy : +/-3% R.H

Range : 0-100% R.H

Output : 4-20 ma

Time constant : 2 mins.

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

**TEMPERATURE / HUMIDITY INDICATOR**

Sensor : RTD for( Pt 100 ) for temperature  
 : Capacitance Type for Humidity (specs for humidity and temperature shall be as mentioned above)

Display : Combined enclosure with two three digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of at least 10 meters.

Range : 0-60 Deg C for temperature.  
 : 0-95.0 % for Relative Humidity.

Accuracy : Better than +/-0.5 % for Temperature  
 : Better than +/-2.5 % for Relative Humidity

Mounting : Table Top/ wall mounting.

Power supply : 240 V AC, 50 Hz.

Output : 4-20 mA signal each for temperature.

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

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

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

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.11.00	<b>SIL CERTIFICATION:</b> All actuators shall be certified for SIL 2 or better.			
3.00.00	<b>SPECIFIC REQUIREMENTS FOR NON INTRUSIVE HARDWIRED ACTUATORS</b>			
3.01.00	<b>INTERFACES:</b> For ON-OFF and INCHING type actuators interface with the control system shall be through hardwired signal only. <ul style="list-style-type: none"> <li>(a) Open/Close command, open/ close status and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local &amp; other protections operated) shall be provided hardwired.</li> <li>(b) The actuator shall be able to accept open/close command at 24V DC with max. 2.5VA load from control system. Accordingly suitable isolated interface in the actuator shall be provided.</li> <li>(c) Open/close command termination logic shall be suitably built inside actuator.</li> <li>(d) For typical wiring diagram Refer Tender Drawing No. 0000-999-POI-A-063 (Except plug &amp; socket connector, if not applicable)</li> </ul>			
3.02.00	<b>TERMINAL BOX:</b> Suitable terminals/ connectors, integral to actuator, for terminating instrumentation & power cables shall be provided. Necessary glands for power cables and instrumentation cables shall be provided.			
3.03.00	<b>TRAINING:</b> Contractor shall provide training on Non-Intrusive hardwired Electric Actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.			
4.00.00	<b>SPECIFIC REQUIREMENTS FOR NON INTRUSIVE FIELDBUS ACTUATORS</b>			
4.01.00	<b>INTERFACES:</b> For ON-OFF and INCHING type actuators interface with the control system shall be through fieldbus network. <ul style="list-style-type: none"> <li>(a) Open/ close commands, open/ close feedback status, disturbance signal etc. shall be available to the Control System through the fieldbus network along with diagnostics. The detailed diagnostics including the actuator operating data shall be available to the DDCMIS through the fieldbus network.</li> <li>(b) All actuators shall be Foundation Fieldbus/ Profibus compatible. However the exact protocol shall be based on finalized protocol of DDCMIS. If Profibus DP protocol is envisaged then actuator shall have two (redundant) Profibus DP ports for connecting the redundant Profibus DP cables. That is if one profibus cable is cut or not working/ not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention.</li> <li>(c) Open/close command termination logic shall be suitably built inside actuator.</li> </ul>			
<b>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATIONS SECTION – VI, PART-B</b> <b>BID DOC. NO.: CS-0011-109(1A)-2</b>	<b>SUB-SECTION-IIIC-8</b> <b>ELECTRIC ACTUATORS</b>	<b>PAGE</b> <b>3 OF 4</b>	

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

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

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
10.02.00				
10.03.00				
10.04.00				
<b>11.00.00</b>				
<b>12.00.00</b>	<p><b>Electric Actuators</b></p> <p>Fieldbus based Non-Intrusive Electrical Actuators with integral starters along with associated accessories etc. shall be supplied on as required basis for Valves / Dampers to meet the functional and the other specification requirements specified elsewhere in the Technical specification.</p> <p>For detailed specification refer chapter “Electric Actuator”, Part B, Section-VI. These actuators shall comply the common requirements of actuators as specified at clause 2.00.00 and specific requirements of Non-Intrusive fieldbus actuators as specified at clause 4.00.00. <b>Specific requirements of Non-Intrusive hardwired actuators specified in clause no. 3.00.00 are not applicable for this project.</b> For Blade pitch actuators specification clause no. 5.00.00 shall be complied.</p> <p>The protocol of fieldbus based non-intrusive electric actuators shall be matching with fieldbus protocol of FGD System DDCMIS, and the same shall be subject to Employer’s approval.</p> <p>For erection and commissioning of above specified actuators, qualified and experienced engineers of actuator manufacturer shall be deputed at site. After successful commissioning of actuators, minimum one qualified and experienced engineer of main package supplier/ actuator manufacturer shall be continuously available at site up to completion of defect liability period (warranty) of actuators, for troubleshooting and maintenance of actuators and proper interfacing with DDCMIS. Qualified and experienced engineers indicated above shall have expertise in all aspects of non-intrusive actuators along with fieldbus protocol and interfacing with DDCMIS.</p>			
<p align="center">LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOCUMENT NO.: CS-0011-109(3)-9</p>	<p align="center">PART-A SUB-SECTION-III-C (C&amp;I)</p>	<p align="center">PAGE 17 OF 19</p>	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
11.02.00	VFD manufacturer to primarily offer Air cooled Design. However in case of large ratings, liquid cooled drives may be accepted subject to employer's approval. In case of liquid cooled system, there shall be no necessity of continuous water supply system (Closed Loop System).		
11.03.00	In case of Air cooled design, the VFD Cooling system shall be such that it puts minimum heat load inside the room and preferably throw the hot air outside the room with ventilation ducts. The Cooling system shall be designed in such a way that the Air Conditioning & Ventilation Air requirements are kept to minimum. The VFD Manufacturer shall furnish the data regarding heat load, air flow requirements during the detailed engineering.		
11.04.00	Air cooled VFDs shall be provided with cooling fans mounted integral to the VFD/ enclosure. The VFD shall include air-flow pressure switches and temperature detectors to monitor proper operation of the air cooling system. If the fan fails, the system must generate the alarm/trip for the fan failure.		
12.00.00	<b>TRANSFORMER:</b>		
12.01.00	Type: Outdoor Mineral oil filled ONAN type or Indoor natural air-cooled Dry type, Three phase unit, rectifier/converter duty type transformer.		
12.02.00	All other components, technical parameters shall be as per applicable IEC/IS.		
12.03.00	Enclosure for Dry Type Transformer (as applicable)  Enclosure shall be of a tested quality sheet steel of minimum thickness 2 mm & shall also accommodate cable terminations. The housing door shall be interlocked such that it should be possible to open the door only when transformer is off. The enclosure shall be provided with lifting lugs and other hardware for floor mounting.		
12.04.00	Core	Shall be High grade non-ageing cold rolled grain oriented silicon steel Laminations.	
12.05.00	Winding conductor	Shall be electrolytic grade copper. Windings shall be of class F insulation.	
12.06.00	Winding temperature Indicator (WTI)	Shall be Platinum resistance type temperature detector in each limb.	
12.07.00	Thermistors	Shall be embedded in each limb with alarm and trip contacts for remote annunciation.	
12.08.00	Temperature rise:	Winding temperature rise shall be as per applicable IEC.	
<b>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</b>	<b>SUB-SECTION II-E-19 VFD</b>	<b>PAGE 7 OF 15</b>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
13.00.00	<b>POWER CONVERTER:</b>		
13.01.00	The static power converter shall consist of a line side converter for operation as a rectifier and a load side power converter for operation as a fully controller inverter. Power converter shall be fast switching, most efficient and low loss type.		
13.02.00	The converter shall be coordinated with the transformers. The converter shall be able to withstand a three phase short circuit current until interrupted by normal breaker operation.		
13.03.00	Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.		
13.04.00	All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.		
13.05.00	The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the whole speed range. If the parallel connection of semiconductor is applied, the above current rating shall not be less than 140% of the above values.		
13.06.00	All power diodes shall be of silicon type with minimum VBO rating at 2.5 times the rated operating voltage.		
13.07.00	The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise nor reducing its service factor due to harmonic currents generated by the inverter operation. The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions / tools.		
13.08.00	The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.		
14.00.00	<b>OUTPUT FILTER (AS APPLICABLE):</b>		
14.01.00	Output/ dv/dt filter shall be provided, if required. It shall be an integral part of the VFD system and included within the VFD enclosure. It shall inherently protect motor from high voltage dv/dt stress.		
15.00.00	<b>DC LINK CAPACITOR (AS APPLICABLE):</b>		
15.01.00	Capacitor shall be of self-healing film or electrolytic type having high life time. The capacitor shall be an integral part of VFD system. DC link Capacitors shall have		
<b>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</b>	<b>SUB-SECTION II-E-19 VFD</b>	<b>PAGE 8 OF 15</b>

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
16.00.00	<p>discharge resistors which shall be capable of reducing the residual charges to zero just after the capacitor is disconnected from the supply source. The capacitor shall be suitable for high ripple currents.</p> <p><b>AC/DC Reactor (As applicable)</b></p> <ol style="list-style-type: none"> <li>1) Type: Dry type, air cored, self cooled, indoor type. Suitable for withstanding earth fault continuously.</li> <li>2) Insulation: Thermal Class 155(F), temperature rise is limited to thermal class 130 (B).</li> <li>3) Noise level shall not exceed value specified in NEMA TR-1.</li> </ol>		
17.00.00	<p><b>VFD PANEL REQUIREMENTS</b></p>		
17.01.00	<p>Enclosure frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material. In case dry type transformer is provided inside VFD panels, the enclosure and in its frame thickness shall be same as indicated in this para.</p>		
17.02.00	<p>The cable entry shall be from the bottom of the panel and a removable bolted un-drilled gland plate.</p>		
17.03.00	<p>All Panels shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 3X or better for MV VFD and IP: 4X or better for LV VFD as per IS/IEC 60947</p>		
17.04.00	<p>Enclosures must be designed to avoid harmonic and inductive heating effects and to shield any outside equipment from interference, enclosing and shielding the complete to eliminate any radio frequency interference. The construction of the panel shall provide effective protection against electromagnetic emissions.</p>		
17.05.00	<p>Each panel shall be provided with illuminating lamp, space heater with switch fuse and variable setting thermostat.</p>		
17.06.00	<p>Proper ventilation using air filters and fans/pumps shall be provided in the panels to ensure that maximum temperature inside the cubicle is within permissible limits for reliable and continuous operation of the system.</p>		
18.00.00	<p><b>PAINTING</b></p> <p>Paint shade shall be as follows</p> <ol style="list-style-type: none"> <li>a) VFD transformer : RAL 5012 (Blue), legend in black letter reactor enclosure</li> <li>b) Motors : RAL 5012 (Blue)</li> </ol>		
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</p>	<p>SUB-SECTION II-E-19 VFD</p>	<p>PAGE 9 OF 15</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	c) VFD Panels : Front and rear panels in Grey (RAL9002). End panel sides in blue (RAL 5012)		
19.00.00	<b>HT SWITCHGEAR</b>		
19.01.00	The technical requirements of HT switchgear shall be as per chapter of HT switchgear in Part-B of Technical specifications.		
20.00.00	<b>MOTORS</b>		
20.01.00	VFD shall be used to drive three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application. These motors shall be provided with insulated bearing on at least one side.		
20.02.00	Motors shall also meet the requirements mentioned in subsection for motors, relevant portions of the specifications for driven equipment and relevant IS/IEC.		
20.03.00	Motor shall be suitable for operation with a solid state power supply consisting of an adjustable frequency inverter for speed control & shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.		
20.04.00	Motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800.		
20.05.00	Drive manufacturer shall coordinate with the motor manufacturer for proper selection of the motor for the given load application and the output characteristics of the drive.		
20.06.00	Other requirements of motor shall be as stipulated in technical chapter of Motors and driven equipment in Part-B of technical specifications.		
21.00.00	<b>LT &amp; HT CABLES</b>		
21.01.00	Contractor's scope shall also include LT and HT cables suitable for VFD system and Motors.		
22.00.00	<b>CONTROL AND PERFORMANCE REQUIREMENTS</b>		
22.01.00	The VFD to provide an automatic current limiting feature to control motor currents during startup and provide a "soft start" torque profile for the motor load combination. Current and torque limit adjustments shall be provided to limit the maximum VFD output current and the maximum torque produced by the motor.		
22.02.00	It shall be possible to vary the speed of the drive and control it in either Local or Remote mode. Local / Remote selection shall be done from VFD panel unless otherwise specified.		
<b>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</b>	<b>SUB-SECTION II-E-19 VFD</b>	<b>PAGE 10 OF 15</b>

CLAUSE NO.	<b>TECHNICAL REQUIREMENTS</b> 		
22.03.00	<p>Provision shall be kept for exchange of information between different VFD control system parameters thru PLC/DDCMIS.</p> <p>Man machine interface for (MV) VFD shall have one flat TFT monitor with keyboard (password protected) in the VFD room and a color laser printer for system alarm and monitoring located in control room.</p> <p>Parameter Monitoring: -Input and output voltage of Drive            - Input and output current of Drive            - Motor speed            - Input and output power frequency of Drive            - Torque            -Input and Output power of Drive system (covering transformer if applicable)            - Output kWhr of Drive            - Transformer (if applicable) temperature for alarm &amp; trip.            - Ambient temperature            - Run/stop and local/remote status displayed</p>		
22.04.00	<p>Drive shall be equipped with a front mounted operator console panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter. Control panel shall be operable with password for changing the protection setting, safety interlock etc.</p>		
22.05.00	<p>Operator console/Main Control Card shall have facility / port to connect external hardware such as Lap-Top etc. Console shall have facility for upload and download of all parameter settings from one drive to another drive for start up and operation.</p>		
22.06.00	<p>User-friendly licensed software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.</p>		
23.00.00	<p><b>PROTECTION FEATURES</b></p>		
23.01.00	<p>The system offered shall incorporate adequate protection features as per IEC 61800-4: 2002 Table-8, properly coordinated for the drive control and for motor including following:</p> <p>i) Converter transformer: short circuit, over current, earth fault &amp; winding temperature high protection.</p> <p>ii) Incoming and outgoing line surge protection.</p> <p>iii) Under / over voltage protection</p> <p>iv) Phase loss, phase reversal, overload, negative phase sequence, locked rotor protection.</p> <p>v) Instantaneous Over current &amp; Earth fault protection</p> <p>vi) Converter/Inverter module failure indication.</p> <p>vii) Over frequency/speed protection.</p>		
<p>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</p>	<p>SUB-SECTION II-E-19 VFD</p>	<p>PAGE 11 OF 15</p>

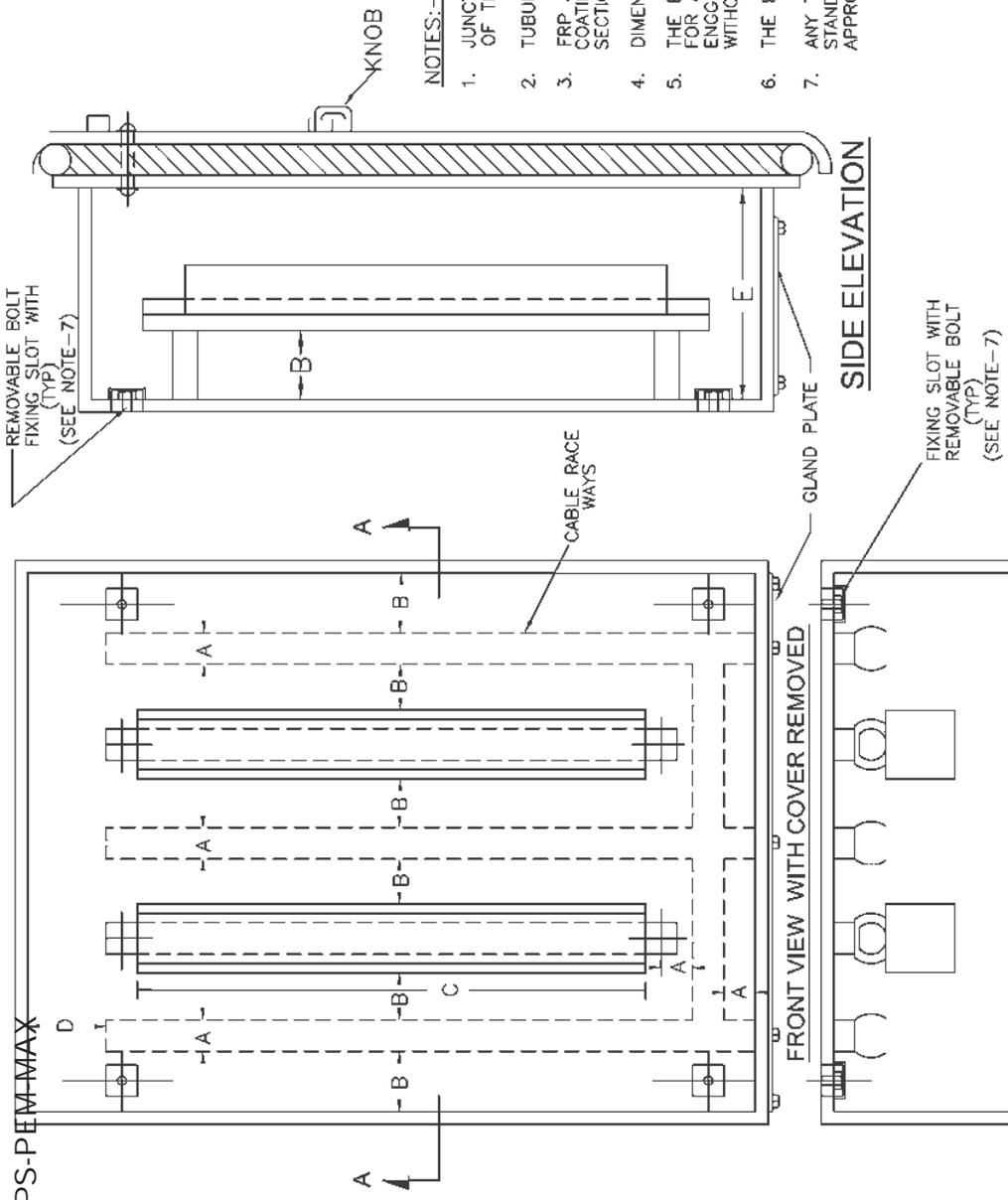
CLAUSE NO.	TECHNICAL REQUIREMENTS		
23.02.00	viii) Ventilation failure indication & alarm. ix) Over temperature of VFD x) Bearing temperature protection. xi) System earth fault protection. xii) Speed reference loss protection.  Under VFD Bypass Mode (if applicable) all the electrical protections related to the Motor shall remain applicable.		
24.00.00	<b>CONTROL FEATURES</b>		
24.01.00	Following controls shall be provided as a part of the Operator Control Panel or through separate switches on the front panel door.  i) Start / stop (in local/remote mode) ii) Speed control (Raise / lower) iii) Acknowledge/Accept/ Test Push Button for annunciation iv) Auto / Manual / Test Mode select v) Emergency stop vi) Trip-Remote Breaker		
25.00.00	<b>DIAGNOSTIC FEATURES</b>		
25.01.00	The VFD shall include a microprocessor/PLC based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.		
25.02.00	Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available. It shall be possible to retrieve the record of events prior to tripping of the system or de-energization. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care of by the manufacturer for this purpose.		
26.00.00	<b>SERVICEABILITY / MAINTAINABILITY</b>		
26.01.00	Power Component Accessibility: All power components in the converter sections shall be designed for rack-out accessibility for ease of maintenance and to minimize repair downtime.		
<b>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</b>	<b>SUB-SECTION II-E-19 VFD</b>	<b>PAGE 12 OF 15</b>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
26.02.00	Marking / Labeling: Sleeve type wire marker tags or other acceptable means of permanent identification shall be applied to power and control wiring. Individual labels shall be provided for all major components of the VFD system.		
27.00.00	<b>STORAGE AND PRESERVATION</b>		
27.01.00	The Contractor shall be responsible for the storage and preservation of all the equipments to be supplied under the VFD System, till the time of successful installation and commissioning. The equipment should be suitable for storage for long periods before installation. Contractor should take adequate measures to ensure that no damage happens to the VFD System due to storage and preservation.		
28.00.00	<b>TESTS</b>		
28.01.00	<b>ROUTINE TESTS</b>		
	All acceptance and routine tests as envisaged in QA section shall be carried out. Charges for these shall be deemed to be included in the equipment price.		
28.02.00	<b>TYPE TESTS</b>		
28.02.01	The Contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.		
28.02.02	The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days' notice shall be given by the Contractor. The Contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.		
28.02.03	In case the Contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Employer for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the Contractor.		
28.02.04	Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried		
<b>LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9</b>	<b>SUB-SECTION II-E-19 VFD</b>	<b>PAGE 13 OF 15</b>

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
28.03.00	<p>out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the Contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.</p> <p><b>LIST OF TYPE TESTS TO BE CONDUCTED</b></p> <p>The following type tests shall be conducted under this contract for MV VFD</p> <ul style="list-style-type: none"> <li>i) Overall efficiency determination of VFD system including transformer/ Harmonic filters etc at motor full load</li> <li>ii) Temperature rise test</li> <li>iii) Noise level</li> <li>iv) Harmonics of No load current.(Input/Output)</li> </ul>		
28.04.00	<p><b>LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED</b></p> <p>The following type test reports shall be submitted for VFD Panels'</p> <p><b>1) VFD panels (For LV VFD)</b></p> <ul style="list-style-type: none"> <li>i. Rated Current/ Output</li> <li>ii. Temperature rise test</li> <li>iii. Noise level test</li> <li>iv. Power Loss Determination Test</li> <li>v. Power factor measurement.</li> <li>vi. Degree of Protection Test</li> <li>vii. EMC Test</li> <li>viii. The Fast transient SWC tests as per ANSI / IEEE C37.901-2002 / IEC 60255-22-04-2008 / IEC 61800</li> </ul> <p><b>2) VFD panels (For MV VFD)</b></p> <ul style="list-style-type: none"> <li>i. Rated Current/ Output</li> </ul>		
LOT-3 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO : CS-0011-109(3)-9	SUB-SECTION II-E-19 VFD	PAGE 14 OF 15

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- A - 75 mm
- B - 25 mm
- C - SEE NOTE-4
- D - 100 mm
- E - 150 mm

**NOTES:-**

1. JUNCTION BOXES SHALL HAVE GLAND PLATES AT THE BOTTOM OF THE BOX ONLY.
2. TUBULAR TYPE GASKETS WILL BE USED.
3. FRP JUNCTION BOXES, SHALL BE PROVIDED WITH POLYETHERENE COATING. ALSO REFER SUB SECTION INST CABLE, PART-B SECTION-VI FOR DETAILS.
4. DIMENSION OF 'C' SHALL BE BASED ON NO. OF TERMINAL BLOCKS.
5. THE EXACT TYPE & DIMENSION OF JUNCTION BOXES TO BE USED FOR A PARTICULAR APPLICATION SHALL BE AS DECIDED DURING DETAIL ENCG. STAGE AND SHALL BE SUBJECT TO EMPLOYER'S APPROVAL WITHOUT ANY PRICE REPERCUSSION.
6. THE KNOB FOR ALL THE JUNCTION BOXES SHALL BE IDENTICAL.
7. ANY TYPE OF SEALED FIXING ARRANGEMENT AS PER MANUFACTURER'S STANDARD CAN ALSO BE PROVIDED SUBJECT TO EMPLOYER'S APPROVAL.

**FOR TENDER PURPOSE ONLY**

 <b>NTPC LIMITED</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION		PROJECT TYPICAL THERMAL POWER PLANT	
TITLE G.A. OF JUNCTION BOX		DATE 21.08.12	
APPD 04.05.05		DATE 04.08.06	
ARCH. C&I		ARCH. C&I	
M E C C&I ARCH.		M E C C&I ARCH.	
DRAWN S.K.		DESIGN S.K.	
CHKD. S.K.		CHKD. S.K.	
REV. NO.		REV. NO.	
DESCRIPTION G.A. OF JUNCTION BOX		DRG. NO. 0000-999-POI-A-017	
SIZE A4		SCALE N.T.S.	
REV. NO. D		REV. NO. D	

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CLEARED BY





Cheklist for Serial Communication between DCS System and Foreign Device			
<b>A Device Specific :</b>			
SN	Parameters	Options available	Remarks if any
1	Model No.& Make of Device		
2	Communications Link Options	<input type="checkbox"/> Multidrop <input checked="" type="checkbox"/> Peer to Peer <input type="checkbox"/> N/w topology attached	
3	Protocol Mode (Device is a)	<input type="checkbox"/> Master <input type="checkbox"/> Slave <input type="checkbox"/> Master/Slave	
4	Protocol	<input type="checkbox"/> RTU <input type="checkbox"/> ASCII <input type="checkbox"/> Other -----	
5	Master	<input type="checkbox"/> System maxDNA <input type="checkbox"/> Other -----	
6	Redundancy Requirements	Yes / No	
7	Dist.bet.DCS System & Device*	<input type="checkbox"/> ----- Feet <input type="checkbox"/> ----- Meters	
<b>B Electrical Specific :</b>			
1	Interface Type	<input type="checkbox"/> RS232 <input type="checkbox"/> RS422 <input type="checkbox"/> RS485	
2	Wiring at Device end	<input type="checkbox"/> 2 Wire <input type="checkbox"/> 4 Wire	
3	Transmission Channel	<input type="checkbox"/> Half Duplex <input type="checkbox"/> Full Duplex	
4	Baud Rates (bps)	<input type="checkbox"/> 1200 <input type="checkbox"/> 2400 <input type="checkbox"/> 4800 <input type="checkbox"/> 9600 <input type="checkbox"/> 19200	
5	Databits	<input type="checkbox"/> 8 <input type="checkbox"/> 7	
6	Stopbits	<input type="checkbox"/> 1 <input type="checkbox"/> 2	
7	Parity	<input checked="" type="checkbox"/> None <input type="checkbox"/> Odd <input type="checkbox"/> Even	
8	H/w & Software Handshake	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9	Response Timeout time (Sec)	<input type="checkbox"/> ----- <input type="checkbox"/> Configurable timeout	
10	Data Formats Supported	<input type="checkbox"/> Boolean <input type="checkbox"/> Real <input type="checkbox"/> Char <input type="checkbox"/> Sn.Int <input type="checkbox"/> UnSn.Int	
11	Transmission mode	<input type="checkbox"/> Asynchronous <input type="checkbox"/> Synchronous	
<b>C Application Specific : *</b>			
1	Primary Function*	<input type="checkbox"/> Data Acquisition <input type="checkbox"/> Data Acquisition & Control	
		<input type="checkbox"/> Download parameter sets	
2	Analog Points to read	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	
3	Analog Points to write	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	
4	Digital Points to read	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	
5	Digital Points to write	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	
6	Memory / Flag Points to read	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	
7	Memory / Flag Points to write	-----Nos. <input type="checkbox"/> Details attached <input type="checkbox"/> Details not attached	
<b>D Hardware Specific :</b>			
1	Cable type	<input checked="" type="checkbox"/> Boolean cable <input type="checkbox"/> Twisted pair cable	
2	Cable Details Enclosed	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
3	Any specific Converter required	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Details enclosed	
<b>E Device Documents :</b>			
1	Manufacturer's Documents*	<input type="checkbox"/> Tech., Spec. <input type="checkbox"/> Operating Manual	

**\*Notes:**

A6: To identify converter requirement and cable length.

C: Sr.no.1 to 7 are required to be furnished for interface:such as Tagname,Description,point type,modbus(Register) address,EU,range & device address.

C1: What is the primary purpose of the communication link?

E1: Req'd. Contents : This document must provide an overview of the device including its intended use.(a general tech,communication & electrical details)



**C&I SPECIFICATION FOR  
HVAC SYSTEM**

SECTION: C  
SUB SECTION: C&I

**INSTRUMENTATION CABLE  
INTERCONNECTION AND TERMINATION  
PHILOSOPHY**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	<b>INSTRUMENTATION CABLE, CONTROL &amp; POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL (CABLE SUB-TRAYS ETC)</b>			
1.01.00	<b>General requirements</b>			
1.01.01	All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.			
1.01.02	The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope and ensuring completeness of the control system.			
1.01.03	Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.			
1.01.04	cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.			
1.01.05	Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.			
1.01.06	Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sum price without any further cost implication to the Employer.			
2.00.00	<b>SPECIFICATION OF INSTRUMENTATION CABLE</b>			
2.01.00	<b>Common Requirements</b>			
	<b>S. No.</b>	<b>Property</b>	<b>Requirement</b>	
	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.	
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				
2.02.00	S. No.	Property	Requirement		
	4.	Marking :- a. <i>Progressive automatic on-line sequential marking of length in meters to be provided at every one meter on outer sheath.</i>  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.		
	<b>Specific Requirements</b>				
	<b>Specification Requirements</b>		<b>Type-A cable</b>	<b>Type-B cable</b>	<b>Type F &amp; G cable</b>
<b>A. CONDUCTORS</b>					
Cross section area		0.5 sq. mm			
Conductor material		ANSI type KX	ANSI type SX	Annealed bare copper	ANSI type KX
Colour code		Yellow-Red	Black-Red	As per VDE-815	Yellow-Red
Conductor Grade		As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1
No & dia of strands		7x0.3 mm (nom)			
No. of Pairs		2	2	2/4/8/12/16/24 / 48	2
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2		SUB-SECTION-III-C4 INSTRUMENTATION CABLES	PAGE 2 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS					
	<b>Specification Requirements</b>	<b>Type-A cable</b>	<b>Type-B cable</b>	<b>Type F &amp; G cable</b>	<b>Type-C cable</b>	
	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>B. INSULATION</b>					
	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 <sup>14</sup> at 20 deg. C & 1x10 <sup>11</sup> at 70 deg. C.			2.8x 10 <sup>14</sup> at 20 deg. C & 2x10 <sup>11</sup> at 205 deg. C.	
	<b>C. PAIRING &amp; TWISTING</b>					
	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.	
	<b>D. SHIELDING</b>					
	Type of shielding	Al-Mylar tape				
	Individual pair shielding	No	To be provided for F-type cable		No	
	Minimum thickness of Individual pair shielding	No	0.028mm (28 micron)		No	
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2		SUB-SECTION-III-C4 INSTRUMENTATION CABLES	PAGE 3 OF 13		

CLAUSE NO.	TECHNICAL REQUIREMENTS				
Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable	
Overall cable assembly shielding	To be provided				
Minimum thickness of Overall cable assembly shielding	0.055 mm (55 micron)				
Coverage / Overlapping	100% / 20%				
Drain wire provided for individual shield	N.A.	Yes (for F-type) Size- 0.5 sqmm No of strands-7 Dia of strands- 0.3mm Annealed Tin coated copper		N.A.	
Drain wire provided for overall shield	Yes, Size- 0.5 sqmm, No of strands-7, Dia of strands- 0.3mm, Annealed Tin coated copper				
<b>E. FILLERS (if applicable)</b>					
Non-hygroscopic, flame retardant	To be provided				
<b>F. OUTER SHEATH</b>					
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 ASTM D-2863	29 %		N.A.		
Minimum Temperature index as per ASTM D-2863	250 deg.C		N.A.		
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 ASTM-D2843	60%			N.A.
	Reference standard	VDE207 Part 5,VDE-816			VDE207 Part 6 ASTM D2116
	<b>G. Electrical Parameters</b>				
	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.
	<b>H. COMPLETE CABLE</b>				
	Complete Cable assembly	Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.			N.A.
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				
	<b>Specification Requirements</b>	<b>Type-A cable</b>	<b>Type-B cable</b>	<b>Type F &amp; G cable</b>	<b>Type-C cable</b>
	Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification			As per manufacturer's standard subject to employer's approval
	<b>I. CABLE DRUM</b>				
	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			
	<p>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</p>				
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	<b>SPCIFICATION OF CONTROL &amp; POWER SUPPLY CABLES</b>  Refer Electrical sub-sections																																																					
5.00.00	<b>INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY</b>  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.  <b>TABLE A: CABLE TERMINATION TO BE FOLLOWED</b> <table border="1"> <thead> <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> </thead> <tbody> <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> </tbody> </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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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				
<p>6.00.00</p> <p>6.01.00</p>	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
<p>Notes</p> <p>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.</p> <p>2 For analog signals, individual pair shielding &amp; overall shielding &amp; for Binary signals, only overall shielding of instrumentation cables shall be provided.</p> <p>3 * For high temperature applications only.</p> <p>4 . For connection between field/JB and DDCMIS marshalling cabinet Minimum 4 pair instrumentation cable shall be used.</p> <p>5 All the spare cores of instrumentation cable have to be terminated in Marshalling cabinets/ DCS panel end.</p> <p>6 Not used.</p>					
<p><b>TERMINAL BLOCKS</b></p>					
<p>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</p>					
<p>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2</p>	<p>SUB-SECTION-III-C4 INSTRUMENTATION CABLES</p>	<p>PAGE 8 OF 13</p>		

CLAUSE NO.	TECHNICAL REQUIREMENTS								
	<p>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.</p>								
6.02.00	<p>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.</p>								
6.03.00	<p>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.</p>								
6.04.00	<p>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.</p>								
6.05.00	<p>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.</p>								
7.00.00	<p><b>INTERNAL PANELS/ SYSTEM CABINETS WIRING</b></p>								
7.01.00	<p>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.</p>								
7.02.00	<p>All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferrules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.</p>								
7.03.00	<p>All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.</p>								
7.04.00	<p>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.</p>								
7.05.00	<p>All the special tools as may be required for solder less connections shall be provided by Bidder.</p>								
7.06.00	<p>Wire sizes to be utilised for internal wiring.</p> <table border="0"> <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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<p>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2</p>	<p>SUB-SECTION-III-C4 INSTRUMENTATION CABLES</p>	<p>PAGE 9 OF 13</p>						

CLAUSE NO.	TECHNICAL REQUIREMENTS											
8.02.00	<p>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:</p> <table border="0"> <tr> <td>From 11 kV/6.6 kV/3.3 kV tray system</td> <td>-</td> <td>914 mm</td> </tr> <tr> <td>From 415V tray system</td> <td>-</td> <td>610 mm</td> </tr> <tr> <td>From control cable tray system</td> <td>-</td> <td>305 mm</td> </tr> </table>	From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm	From 415V tray system	-	610 mm	From control cable tray system	-	305 mm		
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From control cable tray system	-	305 mm										
8.03.00	<p>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.</p>											
8.04.00	Not in use											
8.05.00	<p>The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables &amp; wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.</p>											
9.00.00	<b>CABLE LAYING AND ACCESSORIES</b>											
9.01.00	<p><b>CABLE LAYING</b></p> <ol style="list-style-type: none"> <li>1 Cables shall be laid strictly in line with cable schedule.</li> <li>2 Identification tags for cables. <ul style="list-style-type: none"> <li>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.</li> </ul> </li> <li>3 Cable tray numbering and marking. <ul style="list-style-type: none"> <li>To be provided at every 10m and at each end of cable way &amp; branch connection.</li> </ul> </li> <li>4 No jointing is permissible for Instrumentation cables. For other cables Jointing for more than 250 Meters run of cable shall be permitted.</li> <li>5 Buried cable protection <ul style="list-style-type: none"> <li>With concrete slabs; Route markers at every 20 Meters along the route &amp; at every bend.</li> </ul> </li> <li>6 Road Crossings <ul style="list-style-type: none"> <li>Cables to pass through buried high density PE pipes encased in PCC. At least 300 mm clearance shall be provided between <ul style="list-style-type: none"> <li>- HT power &amp; LT power cables,</li> <li>- LT power &amp; LT control/instrumentation cables,</li> </ul> </li> </ul> </li> </ol>											
<p align="center">FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2</p>	<p align="center">SUB-SECTION-III-C4 INSTRUMENTATION CABLES</p>	<p align="center">PAGE 10 OF 13</p>									

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing.</p> <p>7 Segregation (physical isolation to prevent fire jumping)</p> <p>a All cable associated with the unit shall be segregated from cables of other Units.</p> <p>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.</p> <p>8 Cable clamping</p> <p>All cables laid on trays shall be neatly dressed up &amp; suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided.</p> <p>9 Optical fiber cables ( OFCs ) :</p> <p>Outside Building Area - to be laid necessarily inside GI conduit with support from cable tray/Trestle structure</p> <p><b>Inside Building Area – to be laid on separate cable sub-trays</b></p> <p>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;</p> <p>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;</p> <p>While crossing canals/river- to be laid in rodent proof HDPE conduits within hume pipe.</p> <p>10 Laying of Network Cable (UTP/STP) :</p> <p><b>Out side Building Area- to be laid necessarily inside GI conduits with support from cable tray / Trestle structure.</b></p> <p><b>Inside Building Area- to be laid necessarily inside GI conduits on separate cable sub-trays.</b></p> <p>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.</p> <p>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.</p> <p>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.</p>		
<p>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2</p>	<p>SUB-SECTION-III-C4 INSTRUMENTATION CABLES</p>	<p>PAGE 11 OF 13</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
9.05.00	<p>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.</p>		
10.00.00	<p><b>FIELD MOUNTED LOCAL JUNCTION BOXES</b></p> <p>(i) No. of ways 12/24/36/48/64/72/96/128 with 20% spares terminals.</p> <p>(ii) Material and Thickness 4mm thick Fiberglass Reinforced Polyester (FRP).</p> <p>(iii) Type Screwed at all four corners for door. Door gasket shall be of synthetic rubber.</p> <p>(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.</p> <p>(v) Type of terminal blocks Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm<sup>2</sup>. A M6 earthing stud shall be provided.</p> <p>(vi) Protection Class IP: 55 minimum for indoor &amp; IP-65 minimum for outdoor applications.</p> <p>(vii) Grounding To be provided.</p> <p>(viii) Color RAL 7035</p>		
11.00.00	<p><b>CONDUITS</b></p>		
11.01.00	<p>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 <b>terne coated steel</b> 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> .</p> <p><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.</p>		
11.02.00	<p>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.</p>		
11.03.00	<p>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.</p>		
11.04.00	<p>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</p>		
<p>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2</p>	<p>SUB-SECTION-III-C4 INSTRUMENTATION CABLES</p>	<p>PAGE 12 OF 13</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
11.05.00	<p>utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.</p> <p>Conduits shall be securely fastened to all boxes and cabinets.</p>		
12.00.00	<p><b>CABLE SUB-TRAY &amp; SUPPORT</b></p>		
12.01.00	<p>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).</p>		
12.02.00	<p>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. &amp; shall be electrically continuous and solidly grounded.</p>		
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.:CS-0011-109(1A)-2	SUB-SECTION-III-C4 INSTRUMENTATION CABLES	PAGE 13 OF 13

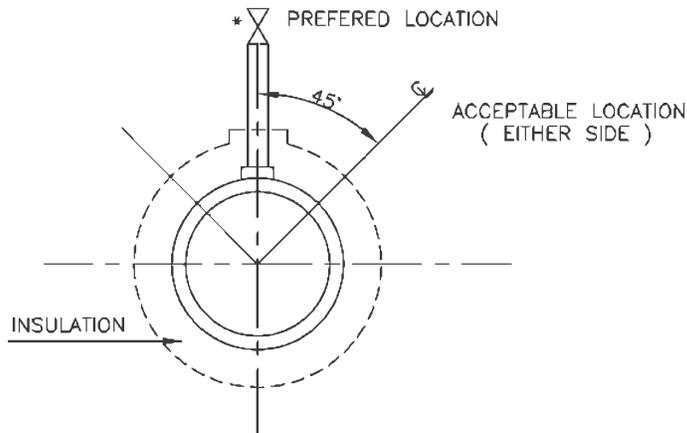
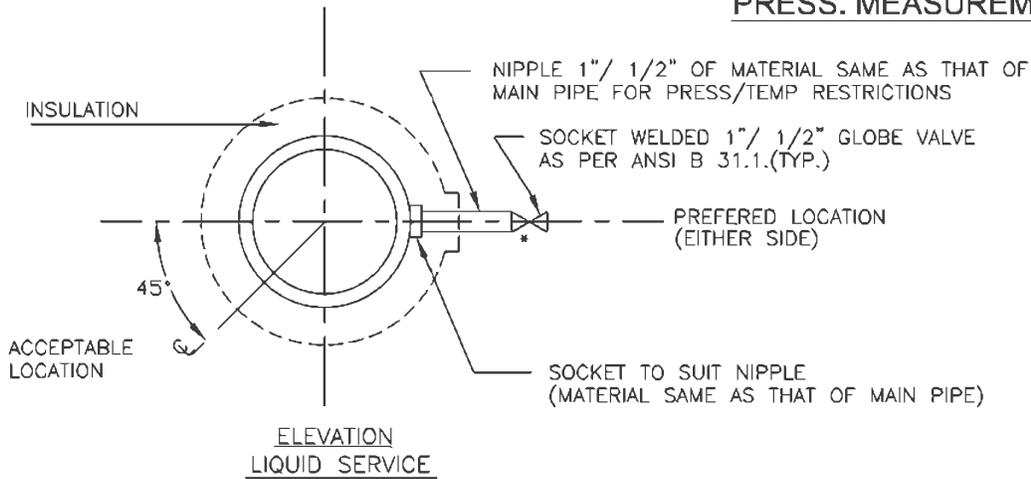


**C&I SPECIFICATION FOR  
HVAC SYSTEM**

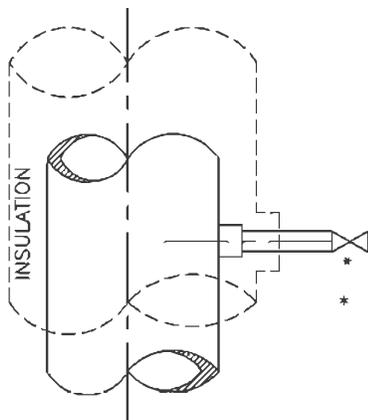
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SUB SECTION: C&I

**INSTRUMENT STUB DETAILS**

**PRESS. MEASUREMENT**



**PRESSURE CONNECTION ON HORIZONTAL PIPE**



**PRESSURE CONNECTIONS ON VERTICAL PIPES**

**FOR TENDER PURPOSE ONLY**



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

PROJECT **TYPICAL THERMAL POWER PROJECT**

TITLE **INSTRUMENT SOURCE CONNECTION DETAILS**

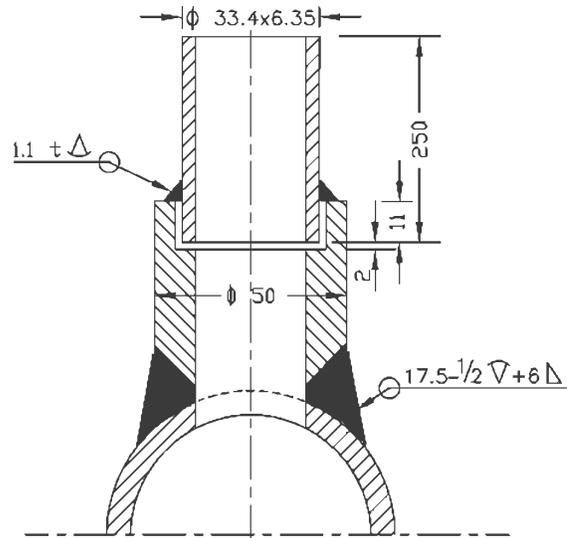
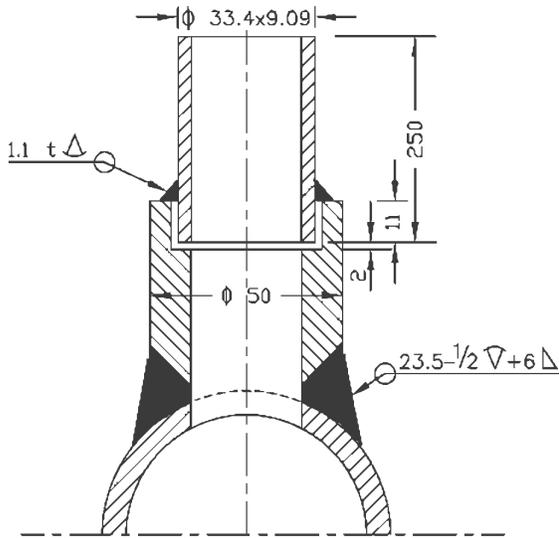
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**PRESSURE MEASUREMENT**

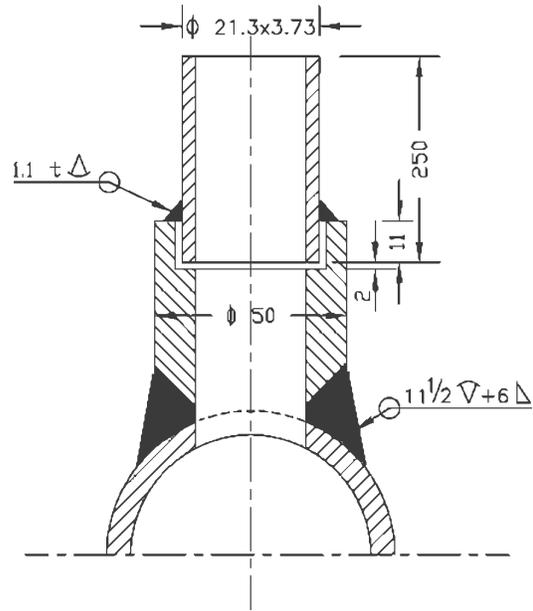
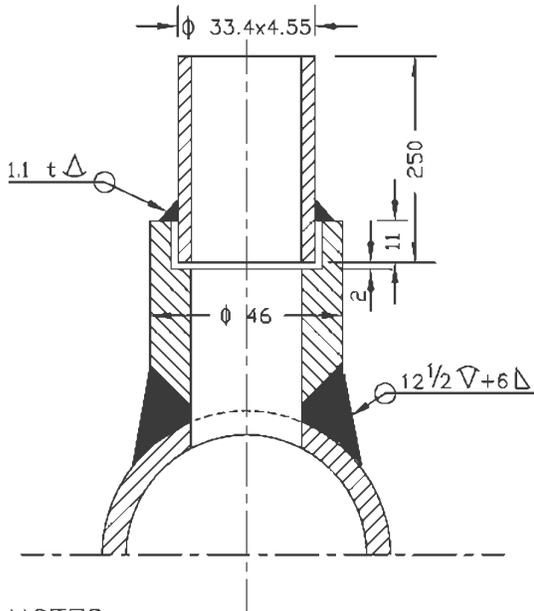
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(SYSTEM PR. >40Kg/Sq Cm CL 6000)



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

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



**NOTES:-**

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFIRM TO ANSI B 16.11.
2. THE LENGTH OF THE NIPPLE SHOULD BE 250mm.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B 16.1.
4. TWO ISOLATED VALVES ARE TO BE USED FOR PRESSURE = >40 Kg/Cm2.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. ORIENTATION OF TAP WILL BE VARY WITH TYPE OF PROCESS FLUID AND NATURE OF RUN OF THE PIPE.
7. ACTIVITIES TO BE COMPLETED AT THE SHOP, WELD THE COUPLING (OR BOSS) ON THE PIPE AND DRILL PRESSURE CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALLIGNMENT WITH HOLE IN THE COUPLING.
8. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.

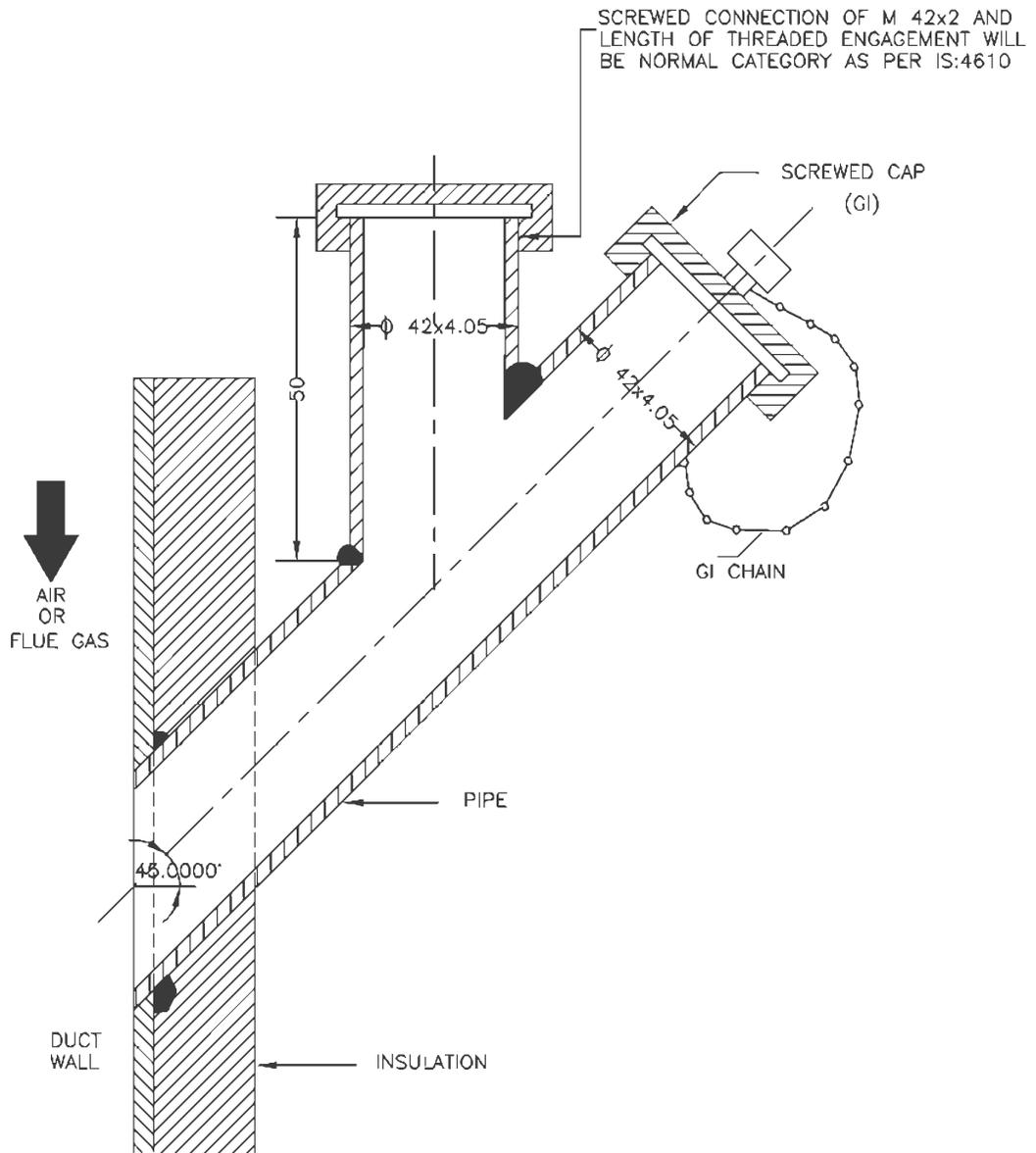
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										 <b>NTPC LIMITED</b> (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION	
PROJECT										TYPICAL THERMAL POWER PROJECT	
TITLE										INSTRUMENT SOURCE CONNECTION DETAILS	
REV. NO.										ORG. NO. 0000-999-POI-A-035	
DESCRIPTION										REV. NO. A	
DRAWN DESIGN CHKD. M E C										SCALE N.T.S.	
T.G. ARCH. APPD. DATE										Sh-2 Of 14	

**PRESS. MEASUREMENT**

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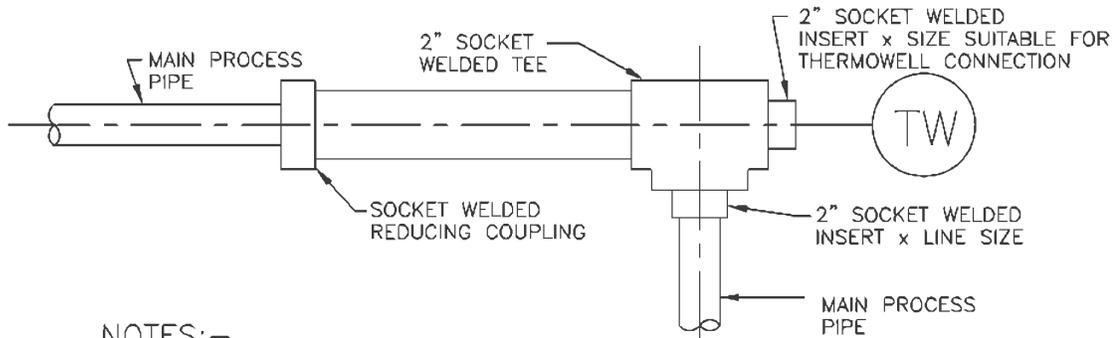
**NOTES:-**

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

FOR TENDER PURPOSE ONLY

<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;"> <p style="margin: 0;">एन टी पी सी <b>NTPC</b></p> </div> <div style="text-align: center;"> <p style="margin: 0;"><b>NTPC LIMITED</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION</p> </div> </div>															
PROJECT					TYPICAL THERMAL POWER PROJECT										
TITLE					INSTRUMENT SOURCE CONNECTION DETAILS										
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
A	FIRST ISSUE										31.08.18	A4	N.T.S.	0000-999-POI-A-035	A
Cleared Page 323 of 525										A4					
										Sh-3 Of 14					

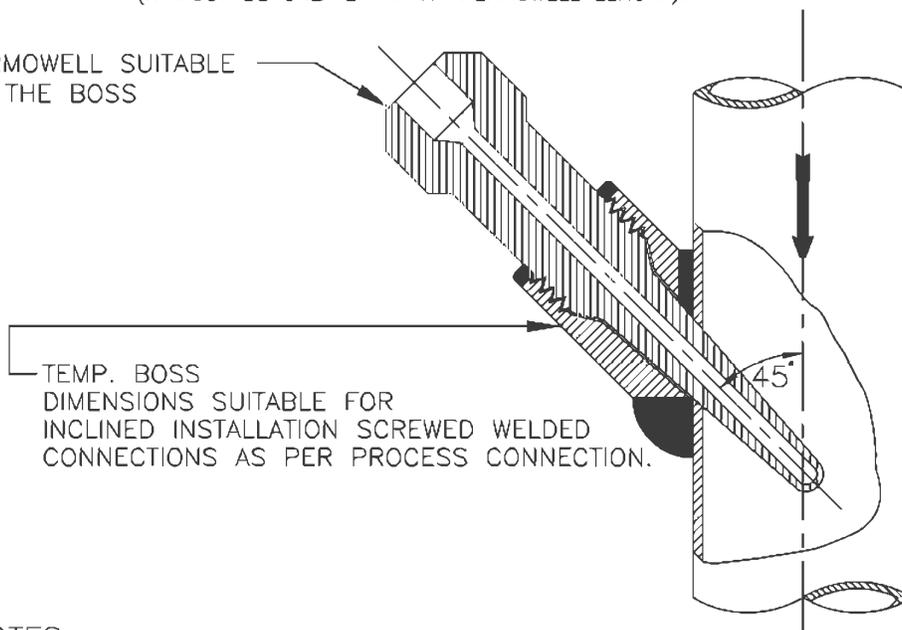
**TEMP. MEASUREMENT**



**NOTES:-**

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

THERMOWELL SUITABLE FOR THE BOSS



TEMP. BOSS DIMENSIONS SUITABLE FOR INCLINED INSTALLATION SCREWED WELDED CONNECTIONS AS PER PROCESS CONNECTION.

**NOTES:-**

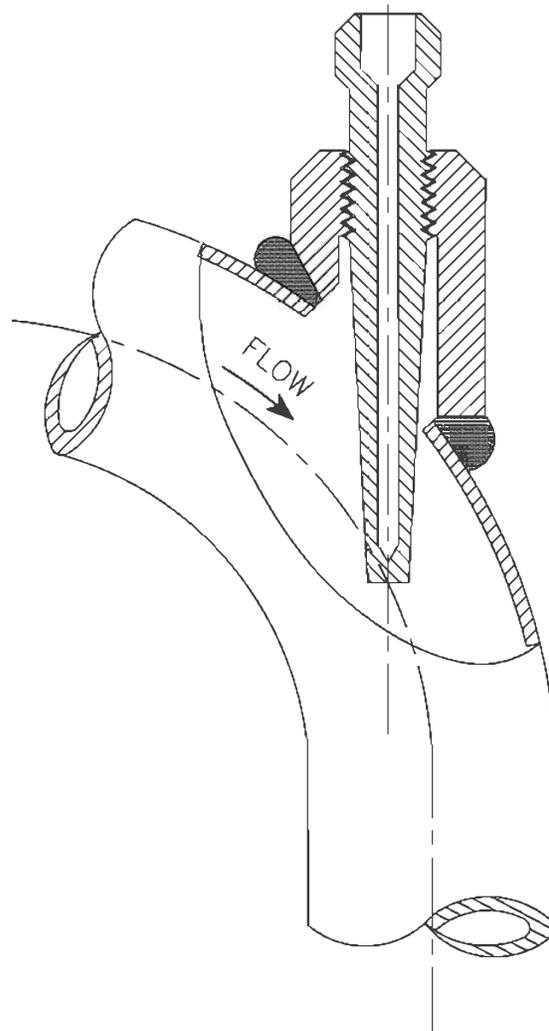
1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL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

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										 <b>NTPC LIMITED</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION	
PROJECT										TYPICAL THERMAL POWER PROJECT (SG PACKAGE)	
TITLE										INSTRUMENT SOURCE CONNECTION DETAILS	
A	FIRST ISSUE								T.G.	91.08.19	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	CRJ	ARCH.	APPD.	DATE
Cleared Page 324 of 525										SIZE	A4
										SCALE	N.T.S.
										DRG. NO.	0000-999/102-POI-A-035
										REV. NO.	A
										Sh-4 Of 14	

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NOTES:-

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

FOR TENDER PURPOSE ONLY

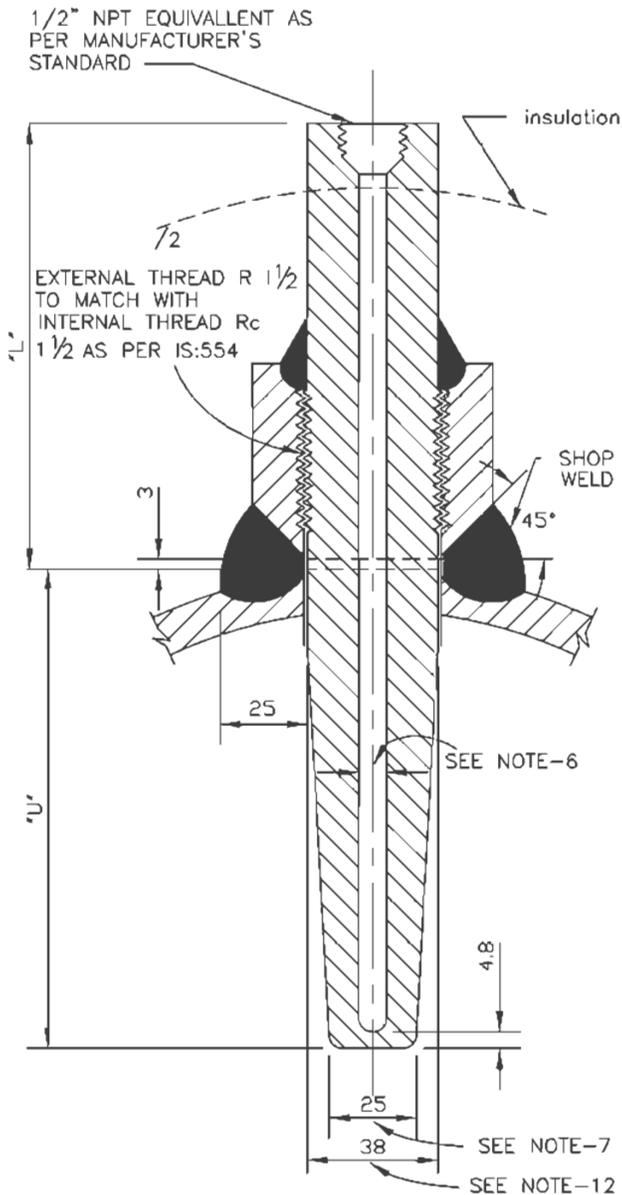


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ENGINEERING DIVISION

PROJECT TYPICAL THERMAL POWER PROJECT

TITLE INSTRUMENT SOURCE CONNECTION DETAILS

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
A	FIRST ISSUE										21.08.19	A4	N.T.S.	0000-999-POI-A-035	A



NOTES:-

1. THIS TYPE OF TEMPERATURE BOSS SHALL BE USED FOR THE PROCESS PRESS EQUAL/ABOVE 40 Kg/Cm2(g).
2. THE MATERIAL OF THE BOSS SHOULD BE SIMILAR TO THAT OF PIPING MATERIAL OF SPECIFICATION.
3. ALL WELD TO BE TESTED IN ACCORDANCE WITH APPLICABLE CODES BY MANUFACTURER.
4. MATERIAL OF THE THERMOWELL SHALL BE OF 316SS.
5. THERMOWELL SHALL BE DRILLED BARSTOCK TYPE.
6. INTERNAL BORE OF THE THERMOWELL SHOULD BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME,PTC-19.3.
7. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESS.AND TEMP.,AS PER ASME,PTC-19.3.
8. THE TYPE OF TAPERED THERMOWELL SHALL BE USED FOR LIQUID VELOCITIES UP TO 92M.P.S.(300F.T.P.S.).
9. THERMOWELL WITH THE INSULATION LAG EXTENSIONS SHALL BE USED WHEREVER APPLICABLE.
10. ACTIVITIES TO BE COMPLETED AT THE SHOP. WELD THE BOSS ON THE PIPE AND DRILL THE HOLE IN THE PIPE IN ALIGNMENT WITH HOLE IN THE BOSS. PROVIDE INTERNAL THREAD AS PER IS:554 TO MATCH WITH THE THERMOWELL EXTERNAL THREAD.
11. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
12. WILL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER RC 1 1/2
13. THE "U" & "L" DIMENSIONS SHALL BE SELECTED BASED ON PARTICULAR APPLICATION AND THE SAME SHALL BE SUBJECT TO OWNER'S APPROVAL DURING DETAILED ENGINEERING.
14. ALL DIMENSIONS ARE INDICATIVE ONLY.

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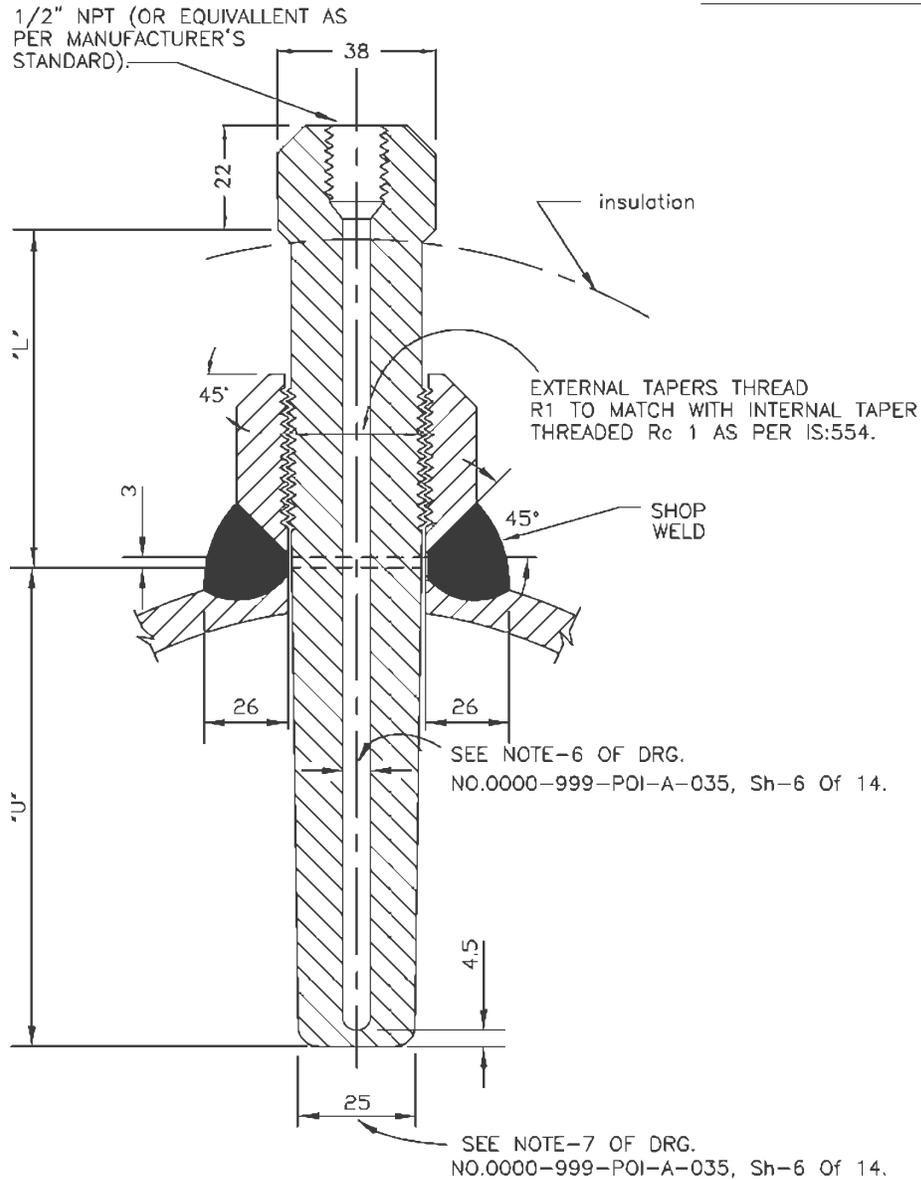
PROJECT TYPICAL THERMAL POWER PROJECT

TITLE INSTRUMENT SOURCE CONNECTION DETAILS

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	W	E	C	CRJ	ARCH.	APPD.	DATE	SIZE	SCALE	ORG. NO.	REV. NO.
A	FIRST ISSUE											A4	N.T.S.	0000-999-POI-A-035	A

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**NOTES:-**

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

FOR TENDER PURPOSE ONLY



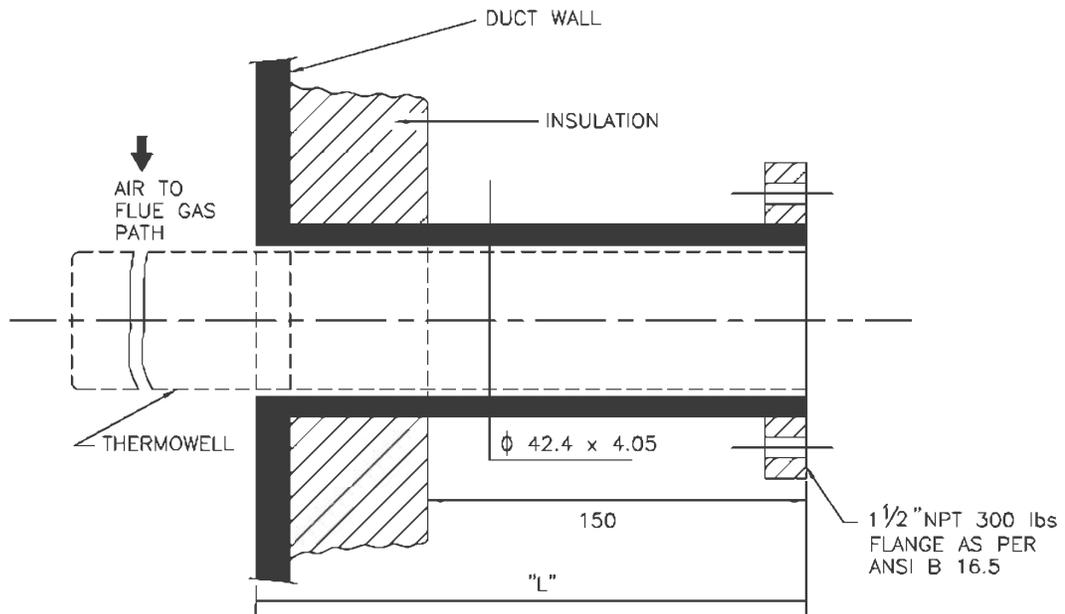
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ENGINEERING DIVISION

PROJECT TYPICAL THERMAL POWER PROJECT

TITLE INSTRUMENT SOURCE CONNECTION DETAILS

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	CR	ARCH.	APPD.	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
A	FIRST ISSUE										31.08.19	A4	N.T.S.	0000-999-POI-A-035	A

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**NOTES: -**

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

FOR TENDER PURPOSE ONLY



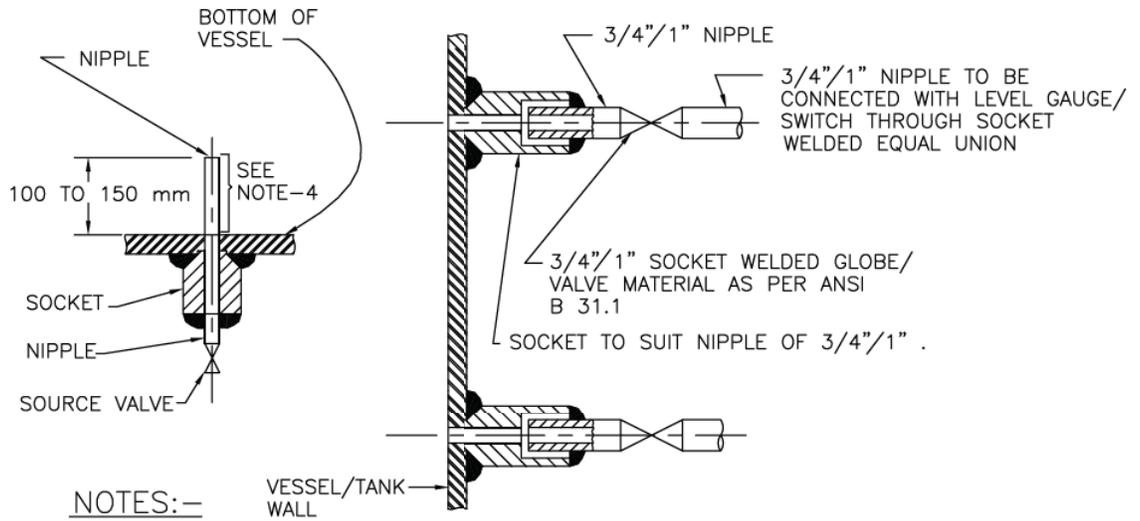
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ENGINEERING DIVISION

PROJECT TYPICAL THERMAL POWER PROJECT

TITLE INSTRUMENT SOURCE CONNECTION DETAILS

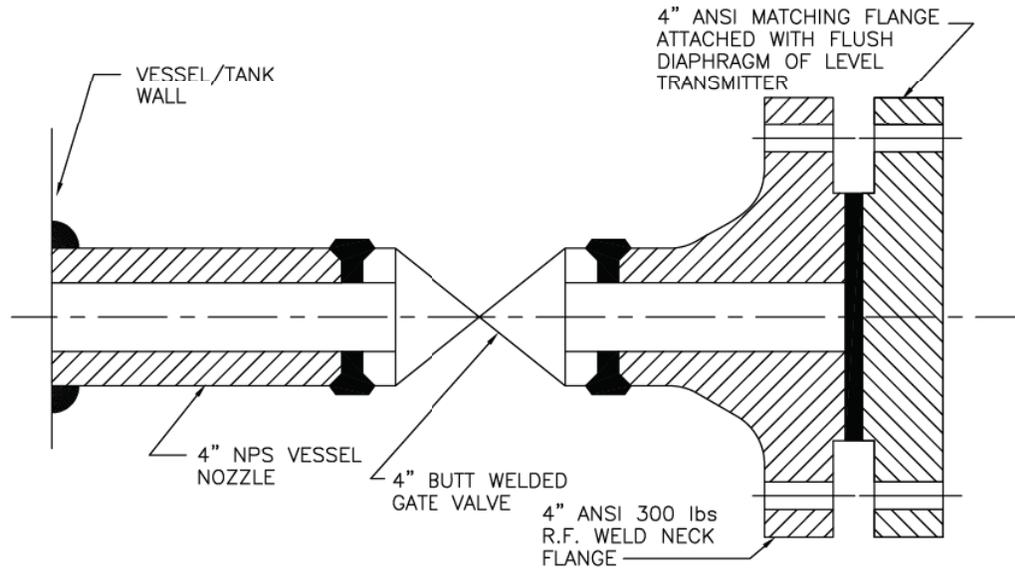
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE	SIZE	SCALE	DRG. NO.	REV. NO.
A	FIRST ISSUE											A4	N.T.S.	0000-999-POI-A-035	A

**LEVEL MEASUREMENT**



**NOTES:-**

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



**NOTES:-**

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

**FOR TENDER PURPOSE ONLY**



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ENGINEERING DIVISION

PROJECT **TYPICAL THERMAL POWER PROJECT**

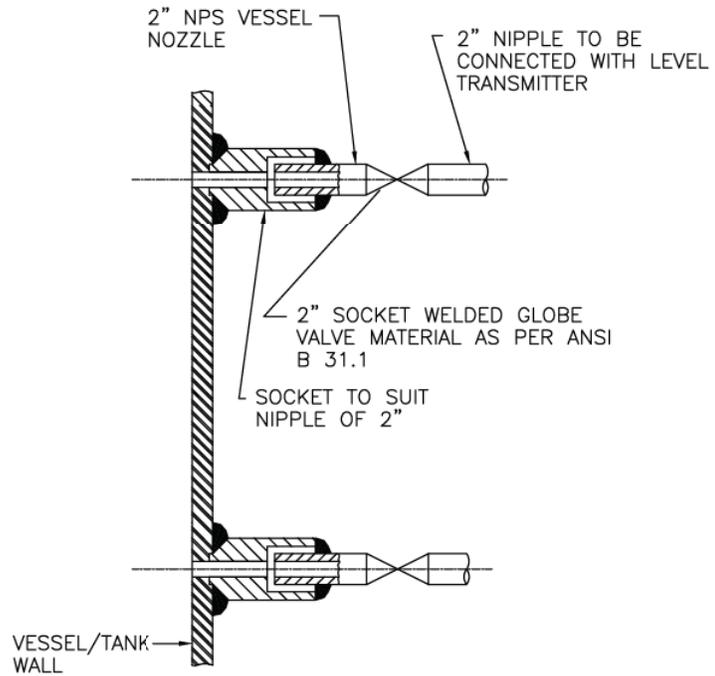
TITLE **INSTRUMENT SOURCE CONNECTION DETAILS**

A	FIRST ISSUE								T.G.	31.08.12	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE

SIZE	SCALE	DRG. NO.	REV. NO.
25A4	N.T.S.	0000-999-POI-A-035	A

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**LEVEL MEASUREMENT**



**NOTES:-**

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

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ENGINEERING DIVISION

PROJECT													TYPICAL THERMAL POWER PROJECT			
TITLE													INSTRUMENT SOURCE CONNECTION DETAILS			
A	FIRST ISSUE								T.G.			31.08.12	SIZE	SCALE	DRG. NO.	REV. NO.
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE		25A4	N.T.S.	0000-999-POI-A-035	A
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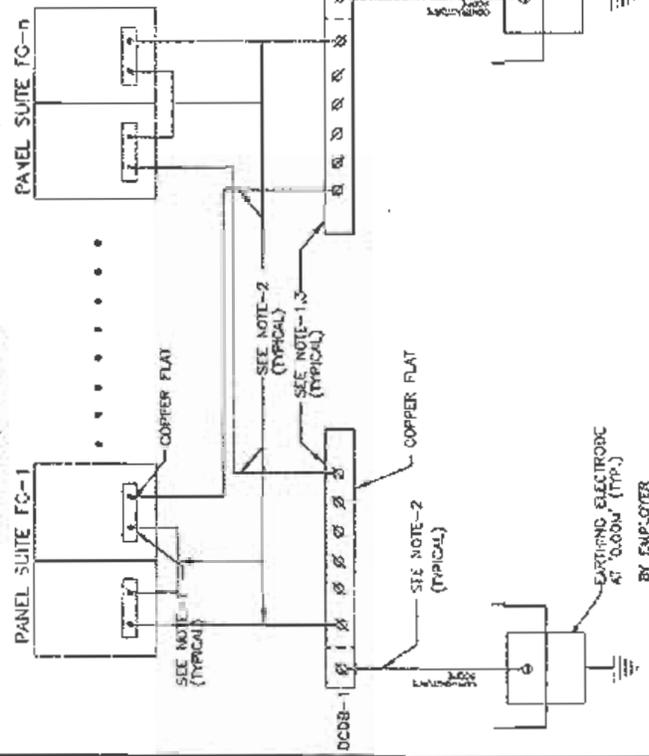
**C&I SPECIFICATION FOR  
HVAC SYSTEM**

SECTION: C  
SUB SECTION: C&I

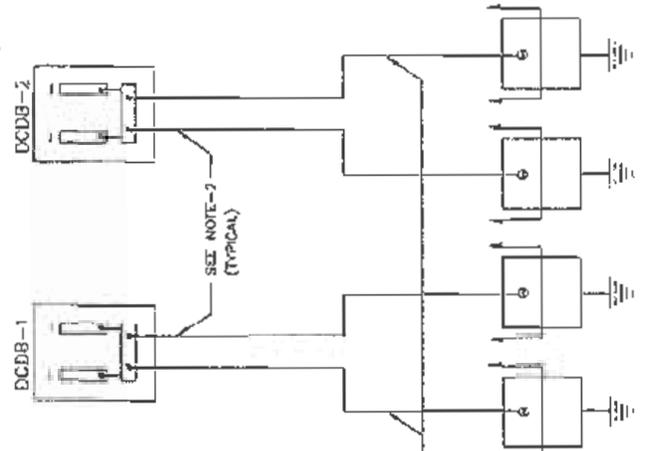
**INSTRUMENT INSTALLATION DRAWING**

51296/2020/PS-PEM-MAX

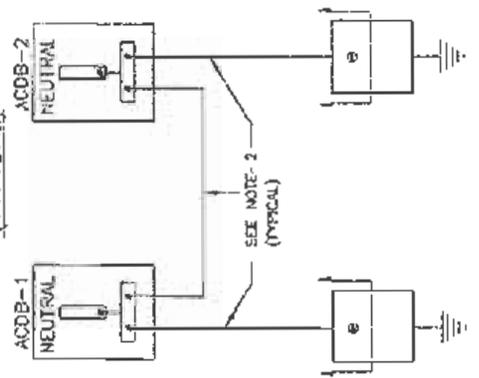
SYSTEM/SHIELD GROUNDING (TYPICAL)



POWER GROUNDING (TYPICAL)



ACDB GROUNDING (TYPICAL)



NOTES:-

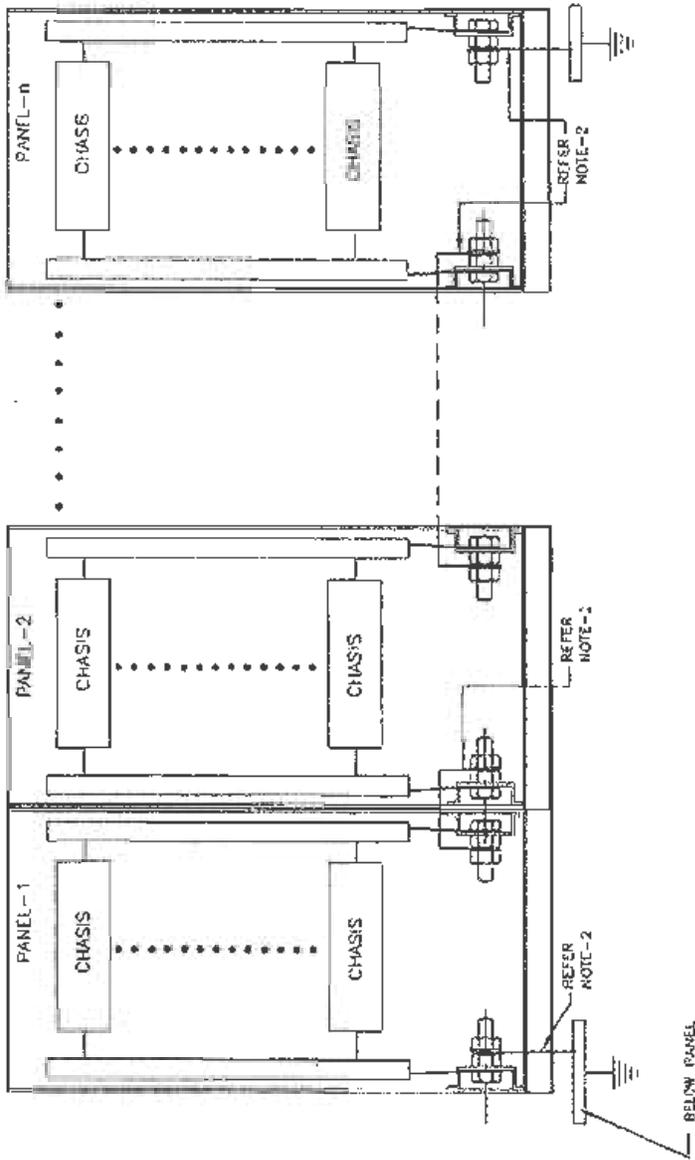
1. SUPPLY, SECTION, TERMINATION OF CABLES, FLATS ETC. REQUIRED FOR PROPER GROUNDING OF CONTRACTOR'S CONTROL SYSTEM, SYSTEM CABINETS, POWER SUPPLY CABINETS ETC. ARE IN THE SCOPE OF CONTRACTOR
2. CABLE IN CONTRACTOR'S SCOPE.
3. TO BE LOCATED IN DCDB.
4. EXACT LOCATION, ARRANGEMENTS OF FLATS ETC. SHALL BE AS FINALISED WITH CONTRACTOR. DURING DETAILED ENGINEERING.
5. CABINET BODY, CABINET BOTTOM PLATE, CABINET DOORS ARE TO BE CONNECTED TO PANEL EARTH FLAT COPPER CABLE BY CONTRACTOR.

FOR TENDER PURPOSE ONLY

		<b>NTPC LIMITED</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION	
PROJECT			
TYPICAL THERMAL POWER PROJECT			
TITLE			
INSTRUMENTATION CABLING DIAGRAM			
GROUNDING SCHEME FOR CABINETS / PANELS / POWER SUPPLY			
REV. NO.	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-019A	A
DATE	APPRO.	CHKD.	SH-1 OF 2
21.06.12			
DESCRIPTION		Page 332 of 525	
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C		E	

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GROUNDING FOR EACH ROW OF PANELS  
(TYPICAL)



NOTES:-

1. SUPPLY, ERECTION, TERMINATION OF CABLES, FLATS ETC. REQUIRED FOR PROPER GROUNDING OF CONTRACTOR'S CONTROL SYSTEM, SYSTEM CABINETS, POWER SUPPLY CABINETS ETC. ARE IN THE SCOPE OF CONTRACTOR.
2. CABLE IN CONTRACTOR'S SCOPE.
3. TC TO BE LOCATED IN DCDB.
4. EXACT LOCATION, ARRANGEMENTS OF FLATS ETC. SHALL BE AS FINALISED WITH CONTRACTOR. DURING DETAILED ENGINEERING.
5. CABINET BODY, CABINET BOTTOM PLATE, CABINET DOORS ARE TO BE CONNECTED TO PANEL EARTH FLAT COPPER CABLE BY CONTRACTOR.

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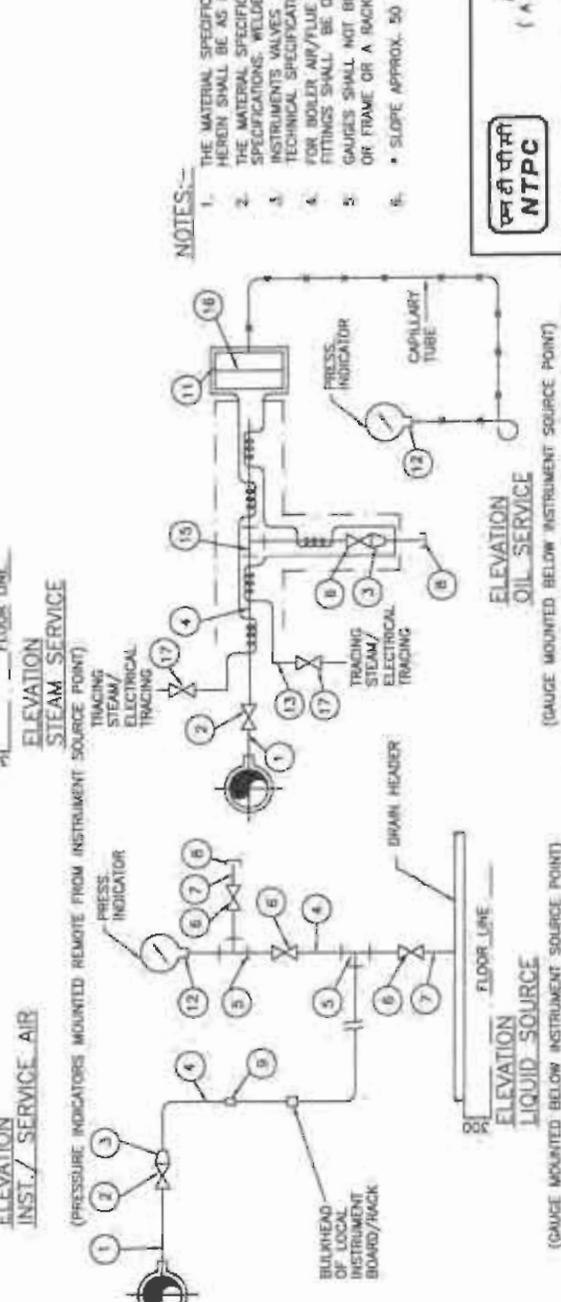
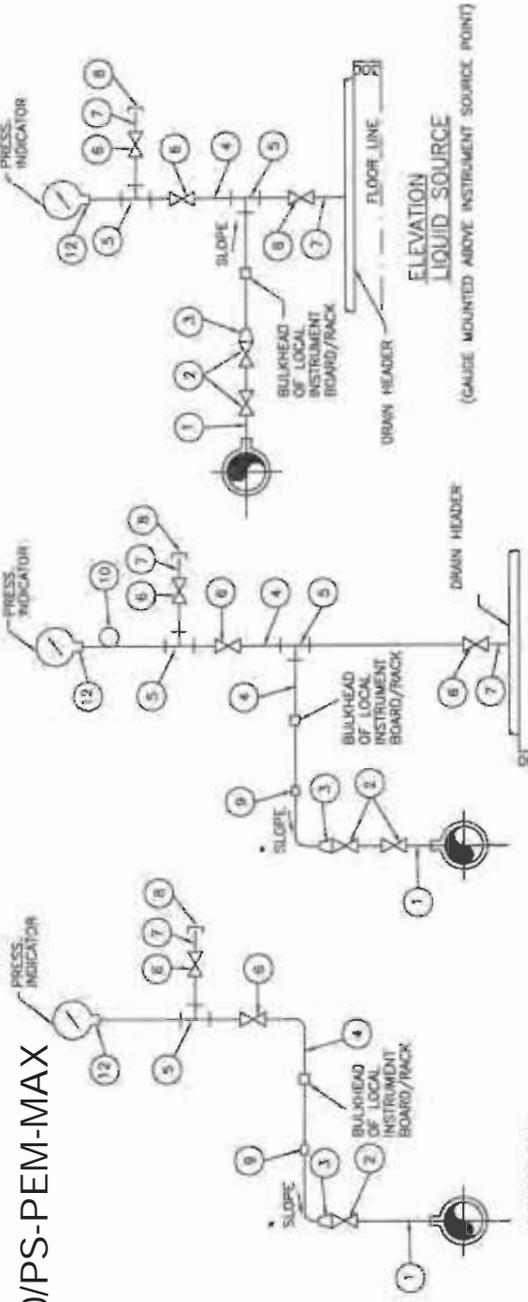


**NTPC LIMITED**  
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ENGINEERING DIVISION

PROJECT		TYPICAL THERMAL POWER PROJECT			
TITLE		INSTRUMENTATION CABLING DIAGRAM GROUNDING SCHEME FOR CABINETS / PANELS / POWER SUPPLY			
SIZE	SCALE	BRG. NO.	DEV. NO.		
A3	N.T.S.	0000-999-POI-A-019A	A	SI-2 OF 2	
DATE	APPD	ARCH	CHE		
21.08.12				Page 333 of 525 CLEARED BY	
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DESCRIPTION					
A	FIRST ISSUE				
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LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2" x 3/4" x 1" NPS SCH 40/80/160/XXX/PS1 (AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	1/2"/3/4"/1" SW GLOBE VALVE/GATE VALVE
3.	3/4" x 1" x 1/2" SW REDUCING INSERT
4.	1/2" / 3/4" PIPE
5.	1/2" / 3/4" SW EQUAL TEE
6.	1/2" / 3/4" SW GLOBE VALVE
7.	1/2" / 3/4" NPS SW x 1/2" / 3/4" NPT(M) CARBON/ALLOY STEEL NIPPLE.
8.	1/2" / 3/4" NPT(F) CAP.
9.	1/2" / 3/4" PIPE UNION
10.	8" SS SYMPHON
11.	1/2" BLIND 300SB RT ANSI FLANGE DRILLED AND TAPED FOR 1" NPT PIPE.
12.	SUITABLE ADAPTER
13.	1/4" CHROME MOLY STEEL TUBE.
14.	
15.	1"/3/4" SW EQUAL TEE.
16.	DAPHRAGM(WATER ELEMENT)
17.	ISOLATION VALVE 316 SS, 1/4" SW



NOTES:-

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

FOR TENDER PURPOSE ONLY



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ENGINEERING DIVISION

TYPICAL THERMAL POWER PROJECT

REV. NO.	DESCRIPTION	DATE	APP'D	CHKD	DESIGN	DRWN
A	FIRST ISSUE	21.08.12				

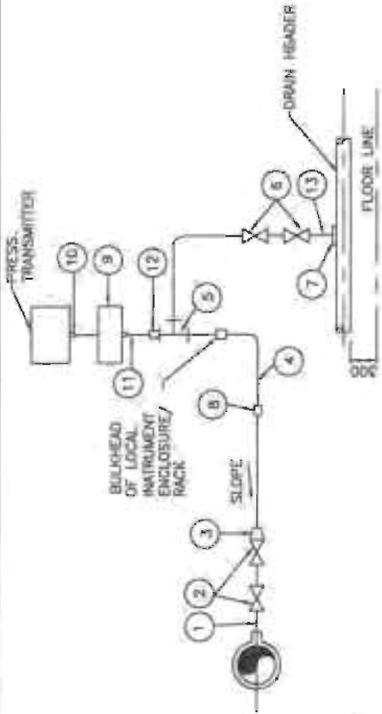
PROJECT	TYPICAL THERMAL POWER PROJECT					
TITLE	INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)					
SIZE	A3	SCALE	N.T.S.	DIRG. NO.		
REV. NO.	0000-999-POI-A-022			REV. NO. A		

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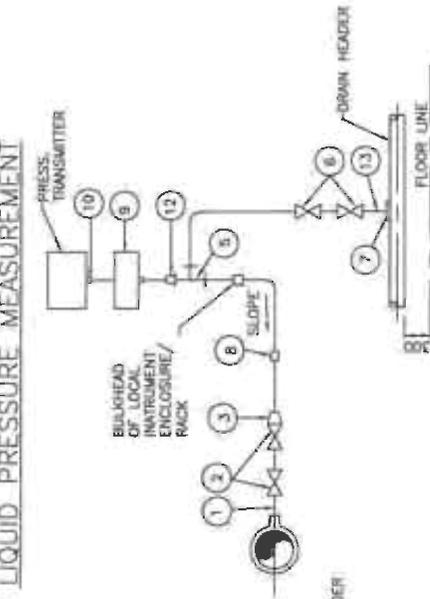
51296/2020/PS-PEM-MAX

LIST OF MATERIALS

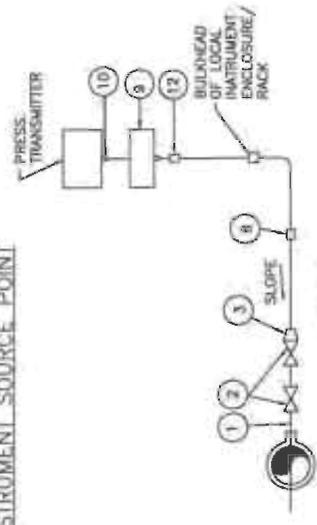
ITEM NO.	DESCRIPTION
1.	1/2" x 3/4" NPS SCH. 80/160/305/PS1 NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	3/4" x 1" SW GLOBE VALVE
3.	3/4" x 1" TO 1/2" REDUCING INSERT
4.	1/2" NPS PIPE
5.	1/2" SW EQUAL TEL
6.	1/2" SW GLOBE VALVE
7.	1/2" NPS SCH. 80/160 SW x 1/2" CS/AS COUPLER
8.	1/2" PIPE UNION
9.	2/3 VALVE MANIFOLD (FOR DETAIL SEE DRAWING NO.0000-102-POI-A-023)
10.	SUITABLE ADAPTER
11.	SS TUBE
12.	1/2" PIPE x 1/2" TUBE UNION
13.	1/2" NPS SCH. 80/160 SW x 1/2" NPT(M) CS/AS NIPPLE



ELEVATION TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT LIQUID PRESSURE MEASUREMENT



ELEVATION TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT STEAM PRESSURE MEASUREMENT



ELEVATION VACUUM PRESSURE MEASUREMENT

NOTES:-  
 1. SAME NOTES UNDER DRG. NO. 0000-999-POI-A-023.  
 2. FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.

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 ENGINEERING DIVISION

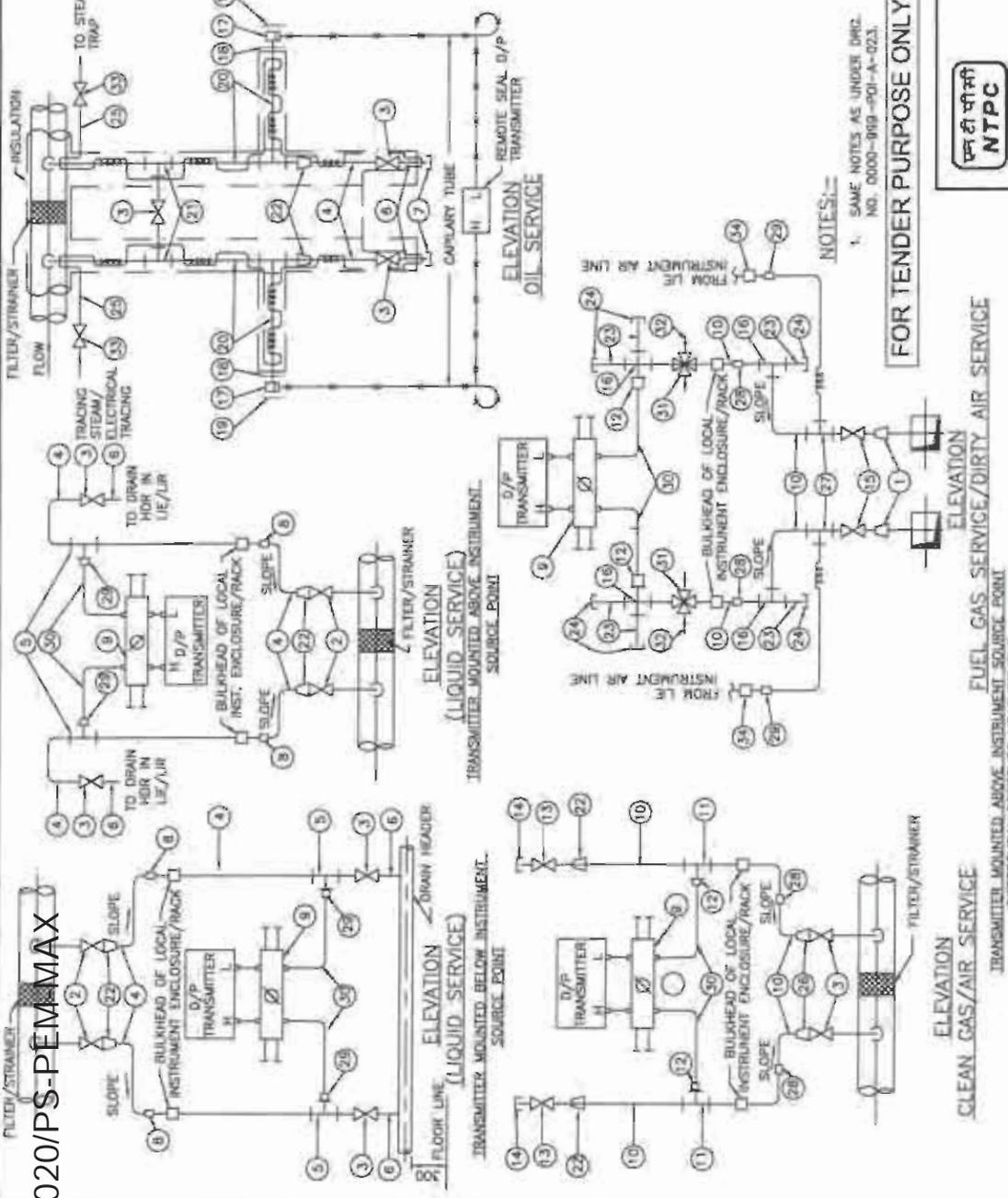
PROJECT		TYPICAL THERMAL POWER PROJECT			
TITLE		INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS /DP TRANSMITTERS STEAM/LIQUID VACUUM)			
REV. NO.	DESCRIPTION	DATE	APPD	ARCH.	REV. NO.
A	FIRST ISSUE	31.08.17			A
DESCRIPTION		DRWN	DESIGN	CHRD.	
		M	E	C	
		C&I			
		T.R.			

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51296/2020/PS-PEM MAX

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	42x2 TO 3/4" SW REDUCING INSERT.
2.	3/4" SW GLOBE VALVE.
3.	1/2" SW GLOBE VALVE FOR LIQUID APPLICATION & 3/4" / 1" IN GAS/AIR APPLICATION.
4.	1/2" NPS 40/80/160 (AS PER PROCESS REQUIREMENT) CARBON/ALLOY STEEL PIPE.
5.	1/2" SW EQUAL TEL.
6.	1/2" NPS SW x 1/2" NPT (M) NIPPLE.
7.	1/2" NPT (F) CAP.
8.	1/2" PIPE x 1/2" PIPE UNION.
9.	5 VALVE MANIFOLD (FOR DETAIL REFER DRAWING NO.0000-999-POI-A-02A).
10.	3/4" SCH 80 CARBON/ALLOY STEEL PIPE.
11.	3/4" x 1/2" SW EQUAL TEL.
12.	3/4" x 1/2" TUBE UNION.
13.	1/2" SCREWED GLOBE VALVE.
14.	1/2" NPT (M) PLUG.
15.	3/4" SW GATE VALVE.
16.	3/4" SW EQUAL CROSS.
17.	WATER ELEMENT FOR USE WITH 3" AND B.F. VALVE.
18.	3 BLIND 300 LB B.T. WELD NECK FLANGE DRILLED FOR 1" SCH. 80/80 PIPE.
19.	3" BLIND FLANGE.
20.	1" NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) CS PIPE.
21.	1" SW EQUAL TEL.
22.	3/4" x 1/2" SW REDUCING INSERT.
23.	3/4" SW x 3/4" NPT (M) CS/AS NIPPLE.
24.	3/4" NPT (F) CS/AS CAP.
25.	1/4" NPS ALLOY STEEL PIPE.
26.	1" x 3/4" SW REDUCING INSERT.
27.	3/4" SW x 1/2" PSW BRANCH TEL.
28.	3/4" PIPE UNION.
29.	1/2" CLAMP UNION (THREADED) SUITABLE FOR FLEXIBLE CONNECTION OF NYLON REINFORCED PVC TUBE.
30.	55 TUBE.
31.	3/4" SW 4 WAY VALVE.
32.	QUICK DISCONNECT FITTING.
33.	1/4" SW ISOLATION VALVE 316SS.
34.	1/2" x 1/2" 55 PIPE UNION.



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NOTES:-  
1. SAME NOTES AS UNDER DRG. NO. 0000-999-POI-A-023.

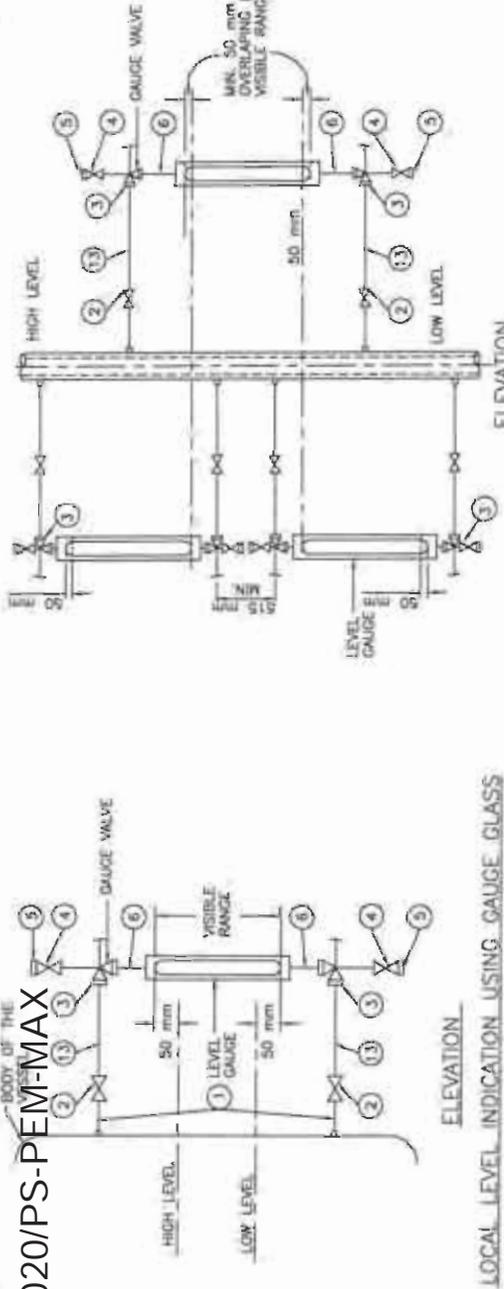


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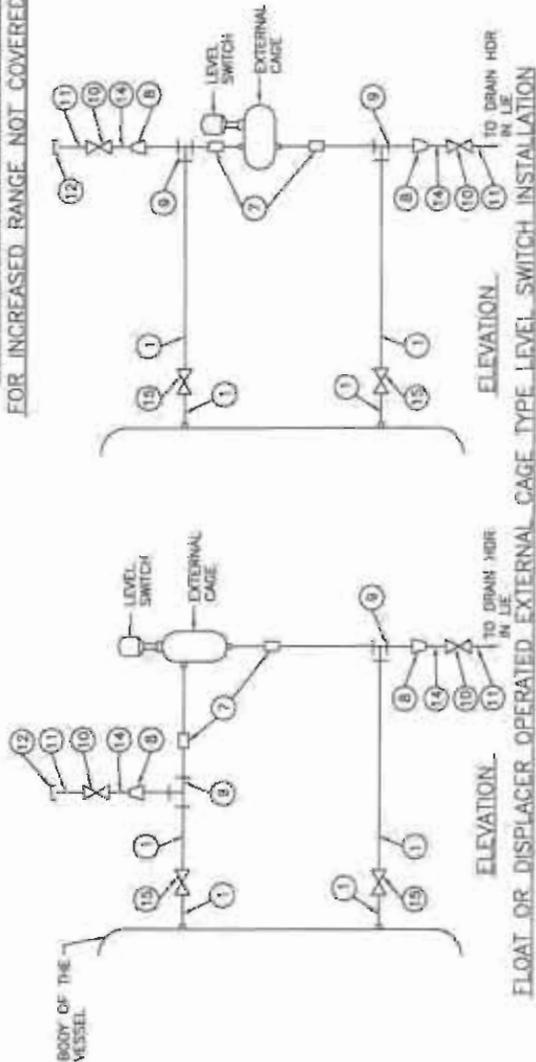
PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INSTRUMENT INSTALLATION DIAGRAM	
DIFF. PRESS. MEASUREMENT (LIQUID, OIL, AIR/GAS SERVICE)		DIFF. PRESS. MEASUREMENT (LIQUID, OIL, AIR/GAS SERVICE)	
REV. NO.	DESCRIPTION	SCALE	DRG. NO.
A	FIRST ISSUE	M E C C B	0000-999-POI-A-030
DATE	APPD	DATE	REV. NO.
21.08.12			A

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51296/2020/PS-PEM-MAX



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



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

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PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INSTRUMENT INSTALLATION DIAGRAM (LEVEL GAUGE & SWITCHES)	
REV. NO.	A	D.R.G. NO.	0000-999-POI-A-031
SCALE	N.T.S.	SIZE	A3
DATE	21.08.17	APPD	
ARCH.		CHKD.	
DESIGN		CHKD.	
DESCRIPTION	F.G. CBI ARCH.		

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CLAUSE NO.	TECHNICAL REQUIREMENTS 								
<b>PROCESS CONNECTION AND PIPING</b>									
1.00.00	<b>PROCESS CONNECTION PIPING</b>								
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	<b>IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS</b>								
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 border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">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>		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
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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	<p>Stainless steel tube shall be provided inside enclosures &amp; racks from tee connection to valve manifold and then to instrument. The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. Two root valves are to be used wherever pressure is more than 40 Kg/cm<sup>2</sup> or Temp&gt;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.</p> <p>The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Manifold</th> <th>Application/Measurement</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>For Pr./D.P gauges, two-way globe/gate valve shall be provided on each impulse line to the instrument in Fluid/Air &amp; Flue Gas applications respectively .</p>	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	<b>AIR SUPPLY PIPING</b>								
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								
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 		
2.04.00	<p>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.</p>		
2.05.00	<p>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.</p>		
2.06.00	<p>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 &amp; trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.</p>		
2.06.00	<p>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.</p>		
3.00.00	<p><b>INSTALLATION AND ROUTING</b></p>		
3.01.01	<p>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.</p>		
4.00.00	<p>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.</p>		
4.00.00	<p><b>SHOP AND SITE TESTS</b></p>		
4.01.01	<p>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 &amp; Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.</p>		
4.01.02	<p>Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.</p>		
5.00.00	<p><b>LOCAL INSTRUMENT ENCLOSURE AND RACKS</b></p> <p>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.</p>		
<p>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-III-C3 PCP</p>	<p>PAGE 2 OF 4</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
5.01.00	<p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Contractor shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR.</p> <p><b>ENCLOSURE / RACKS FOR DUAL I/P TEMPERATURE TRANSMITTERS</b></p> <p>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.</p> <p>The internal layout shall be such that the transmitters are accessible from both front and back side of the enclosure / rack for easy maintenance.</p> <p>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.</p> <p>Enclosure and Racks shall be free standing type.</p> <p>Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein.</p> <p>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.</p>		
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

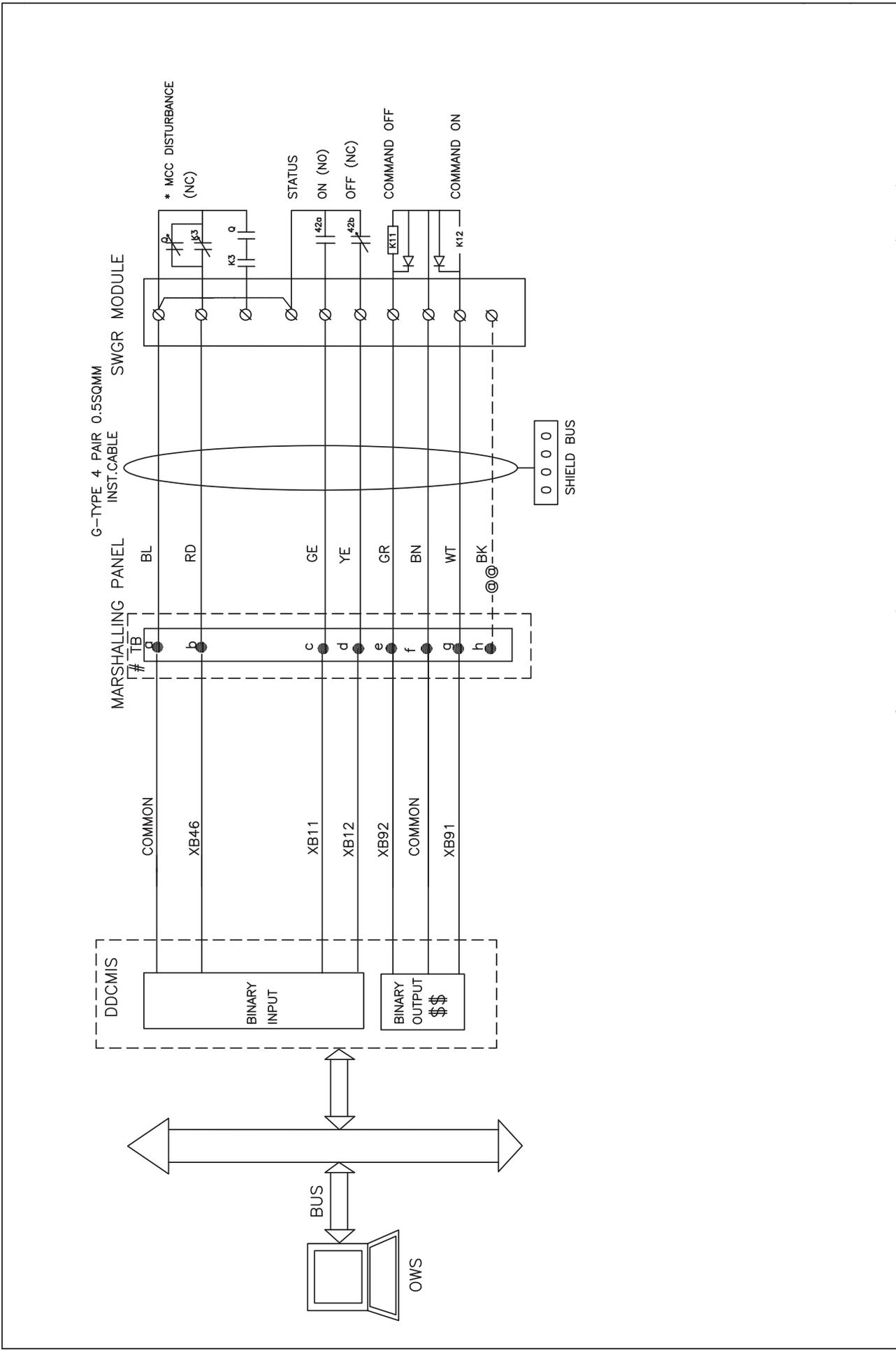


**C&I SPECIFICATION FOR  
HVAC SYSTEM**

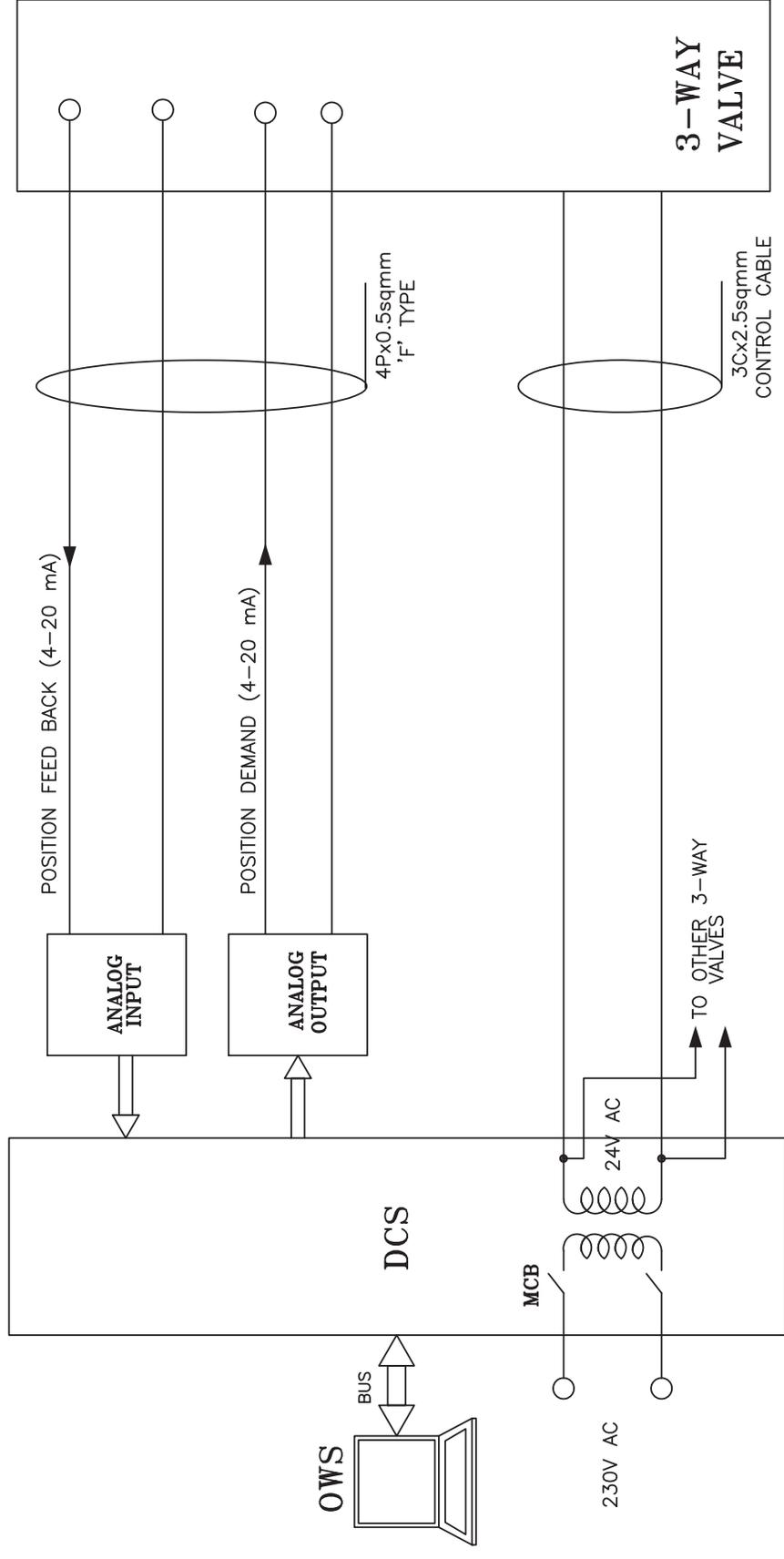
SECTION: C  
SUB SECTION: C&I

**SIGNAL EXCHANGE BETWEEN DRIVES &  
DCS**

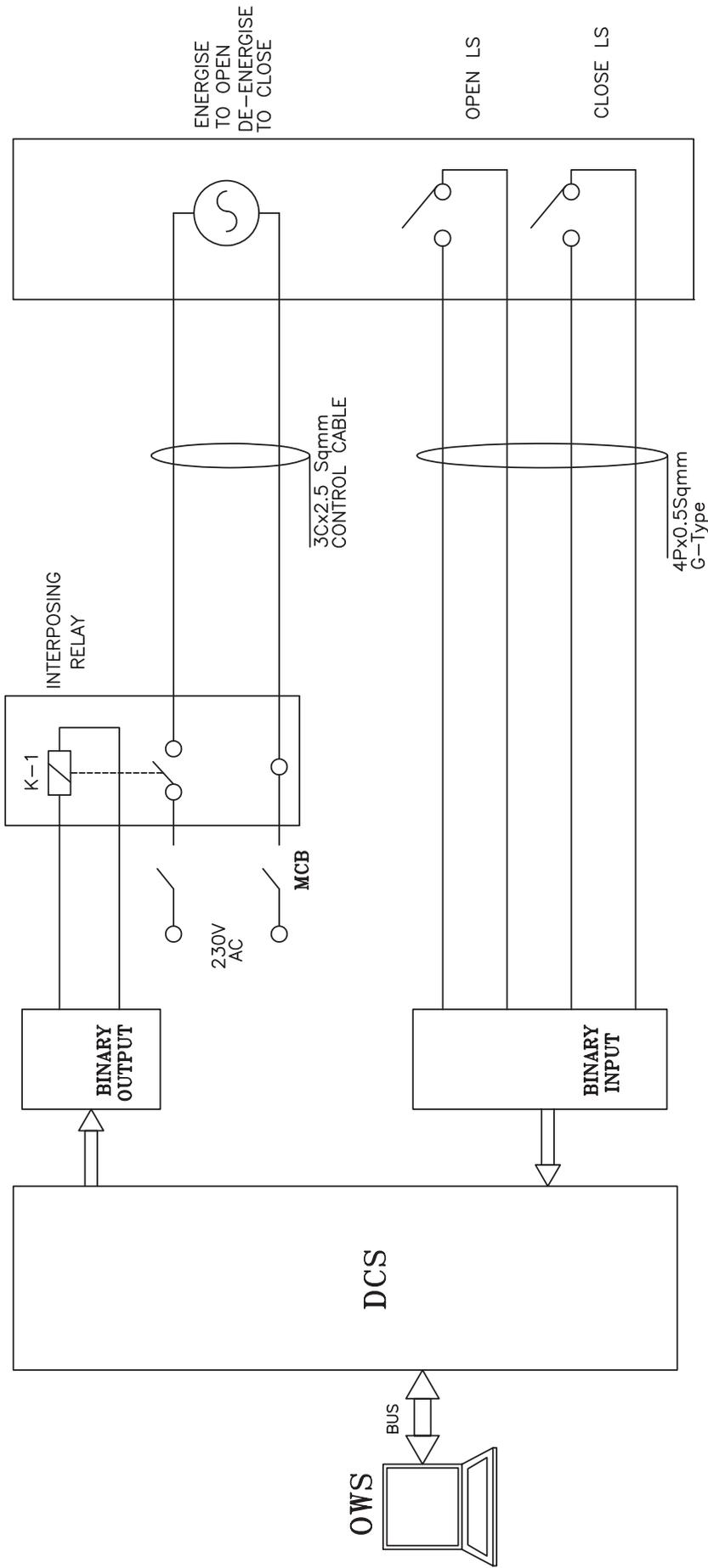
DDCMIS INTERFACE WITH LT MCC (LT)



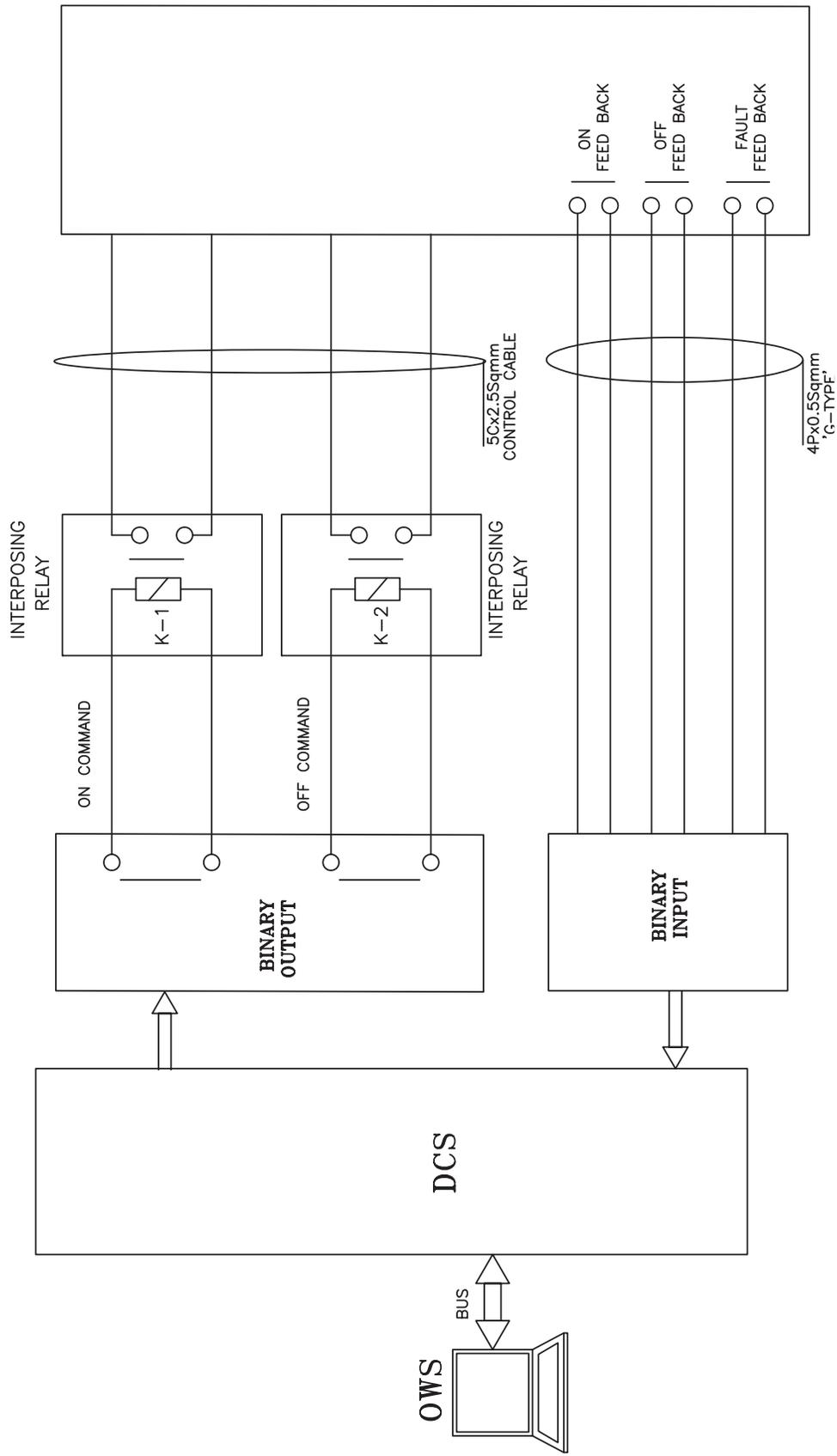
# DCS INTERFACE FOR 3-WAY MIXING VALVE (MOD-AC)



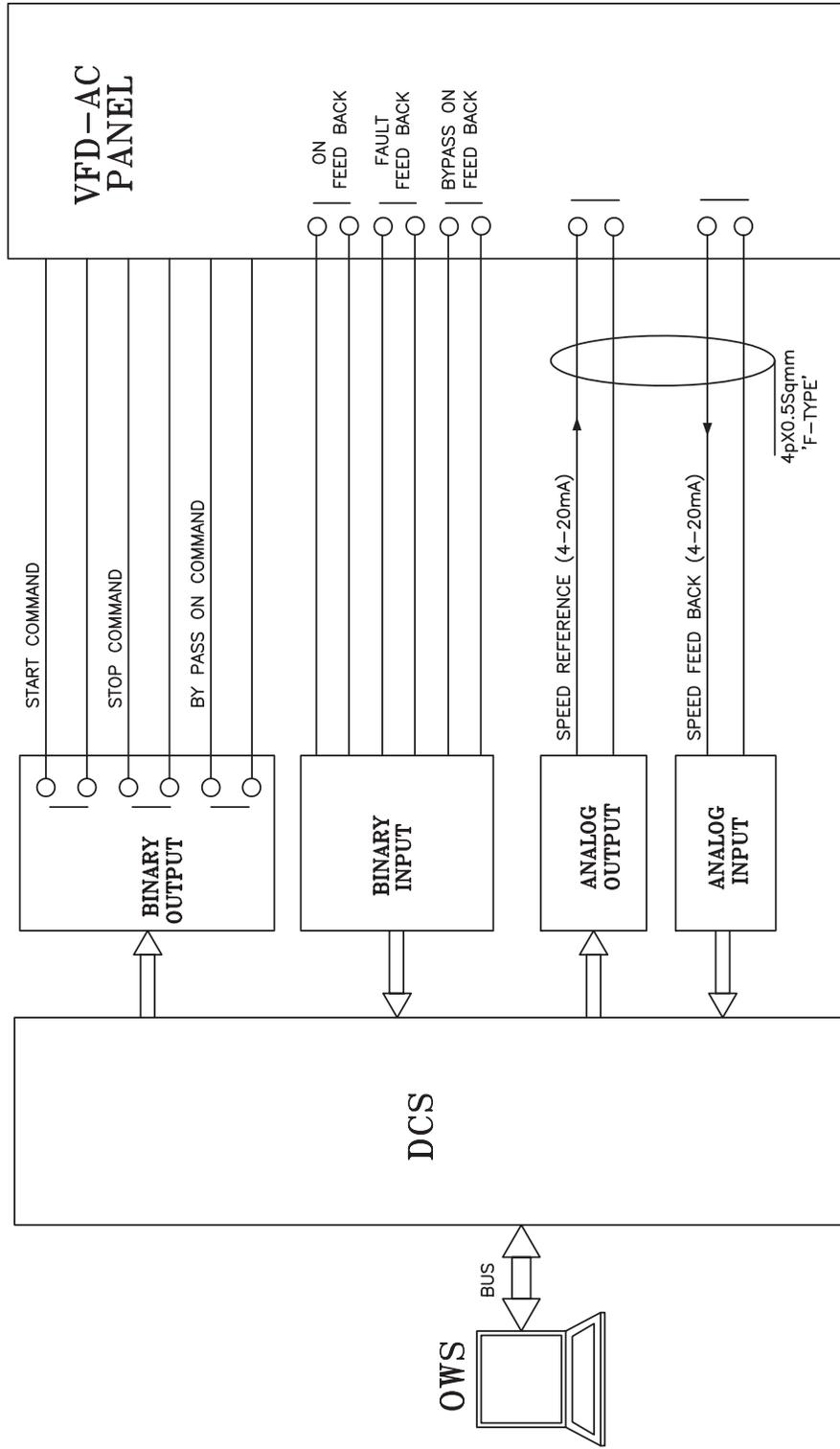
# DCS INTERFACE FOR MOTORIZED OPERATED FIRE DAMPER (BID-FD)



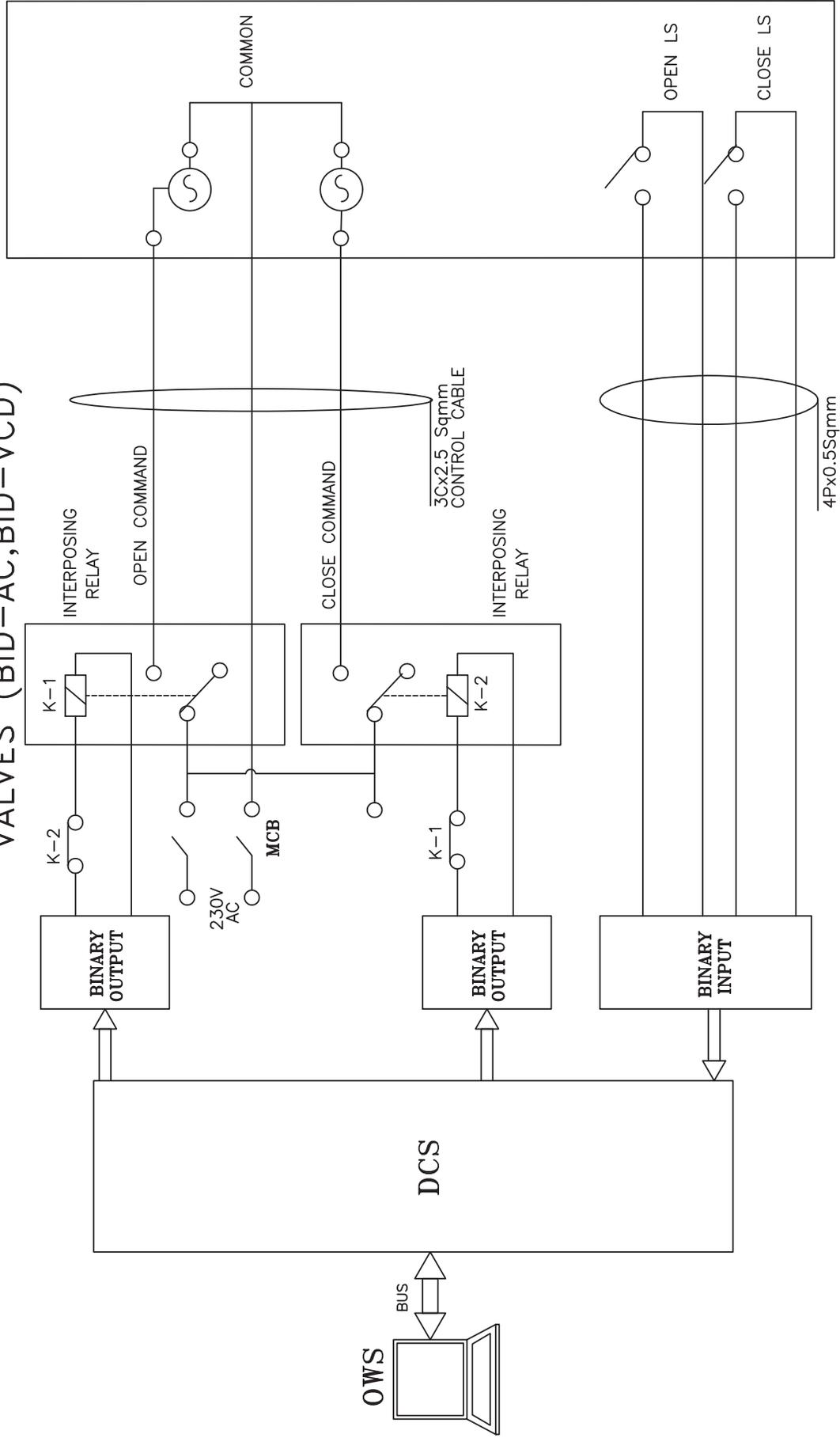
# HOOK-UP DIAGRAM FOR ACCU/SCREW CHILLER



# DCS INTERFACE FOR AHUS VFD(VFD-AC)



# DCS INTERFACE FOR MOTORIZED OPERATED VALVES (BID-AC, BID-VCD)





**C&I SPECIFICATION FOR  
HVAC SYSTEM**

SECTION: C  
SUB SECTION: C&I

**DRIVE & INSTRUMENT INTERFACE  
DIAGRAM**

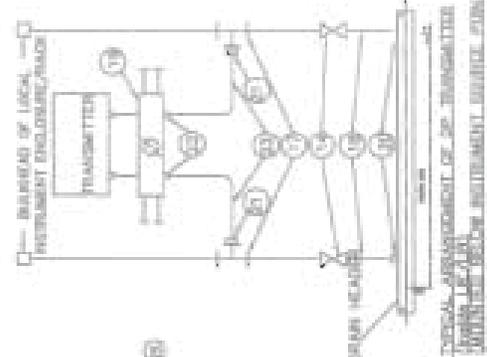
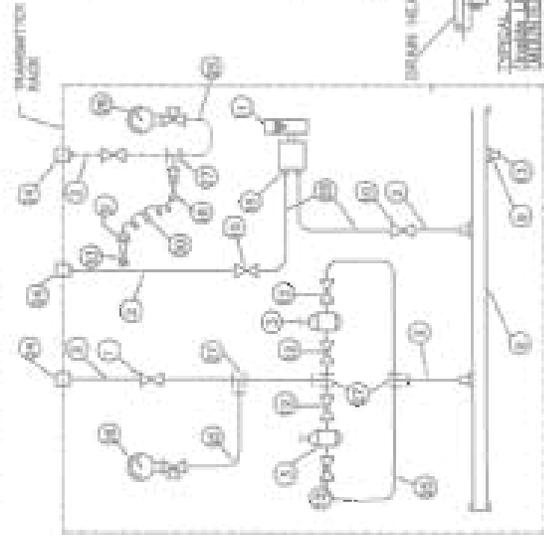
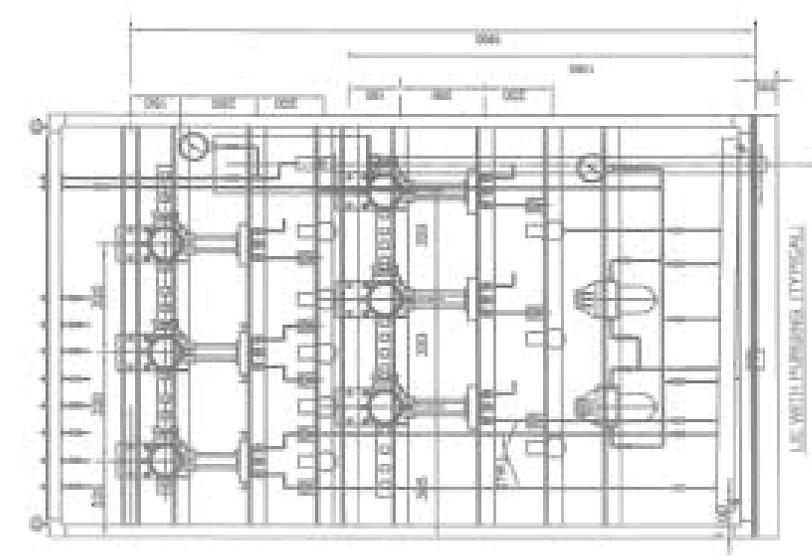
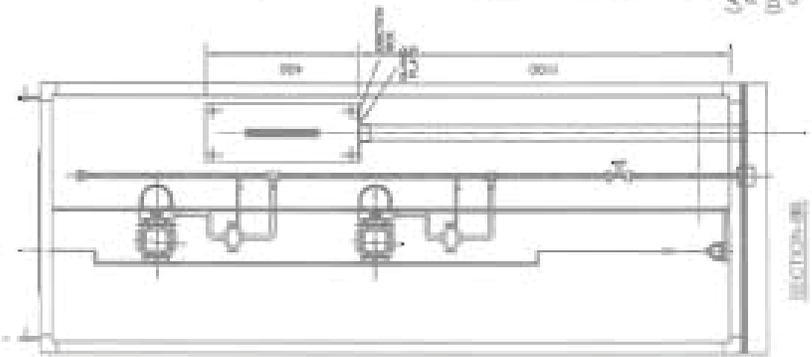
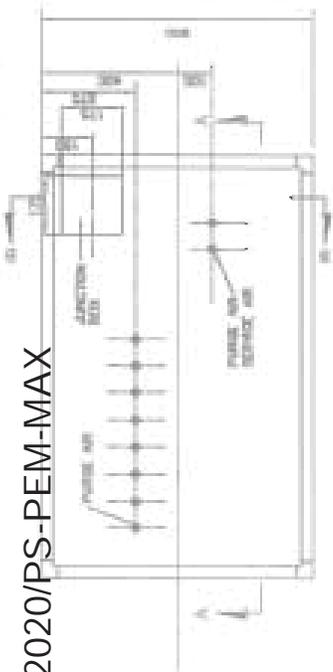
51296/2020/PS-PEM-MAX

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	ISOLATION VALVE(S) (MACH.) BS.
2.	SEALING OF PIPE
3.	AIR FLOW REGULATOR
4.	RED. AIR HEADR. 1/2"
10.	COMP. WASTE VALVE BS.
11.	AIR PURGE SET
12.	COMP. VALVE BS.
13.	PLUG BS.
14.	TUBE IN CONNECTION
15.	TUBE COMP. EQUAL TEE UNION
16.	BLANKING-BS. SUITABLE FOR BS PIPE CONNECTION
18.	SCALDED TUBE BS.
19.	BRANCH TEE BS.
20.	PIPE BRACE
25.	NYLON TUBG. HOSE BRASSD WITH BS NUT.
26.	HOSE BRASSD CORN BS.
28.	ORIG. CONNECTION TO PURGE AIR CONNECTION TO INSTRUMENT SOURCE END)

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
14.	0W GLOBE VALVE
17.	0W EQUAL TEE
19.	2.5" NIPPLE
19.	3" VALVE W/SHIFOLD
20.	0W HALF COMPLET CO
21.	PIPE & TUBE UNION
22.	BLEEDER ADAPTER
23.	3/4 TUBE



USUAL FLUOR AIR CONNECTION INSIDE THE ENCL. ENCLOSURE (APPLICABLE FOR WELL AIR & FLUE GAS SERVICE INSTRUMENTS ACCORDING TO PAGE 401)  
 (Drain Header of each LE/AIR shall be connected to nearest plant drain)

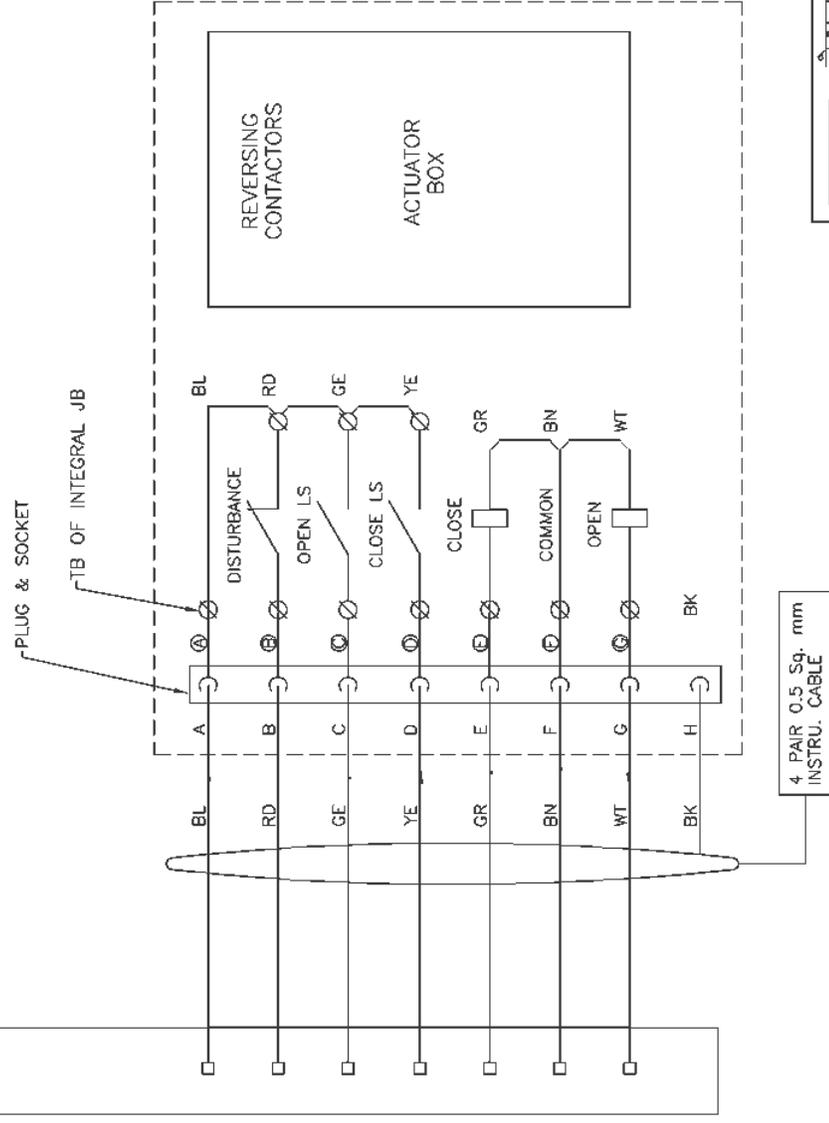
FOR TENDER PURPOSE ONLY

WARRANTY	W T P C LIMITED (A subsidiary of W T P C International Services)
PROJECT	TYPICAL THERMAL POWER PROJECT (TURNKEY EPC PACKAGE)
NO.	TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE PURGING SCHEME (EP TRANSMITTER)
REV.	01/15
DATE	0000-0000-0000-0000
SCALE	AS SHOWN

NO. OF SHEETS	1	TOTAL SHEETS	1
NO. OF PAGES	1	TOTAL PAGES	1
NO. OF FIGURES	1	TOTAL FIGURES	1
NO. OF TABLES	1	TOTAL TABLES	1
NO. OF APPENDICES	1	TOTAL APPENDICES	1
NO. OF DRAWINGS	1	TOTAL DRAWINGS	1
NO. OF SPECIFICATIONS	1	TOTAL SPECIFICATIONS	1
NO. OF BILLS OF MATERIALS	1	TOTAL BILLS OF MATERIALS	1
NO. OF INSTRUMENTATION	1	TOTAL INSTRUMENTATION	1
NO. OF ELECTRICAL	1	TOTAL ELECTRICAL	1
NO. OF MECHANICAL	1	TOTAL MECHANICAL	1
NO. OF CIVIL	1	TOTAL CIVIL	1
NO. OF OTHER	1	TOTAL OTHER	1

51296/2020/PS-PEM-MAX  
 TERMINATION AT  
 CONTROL SYSTEM END

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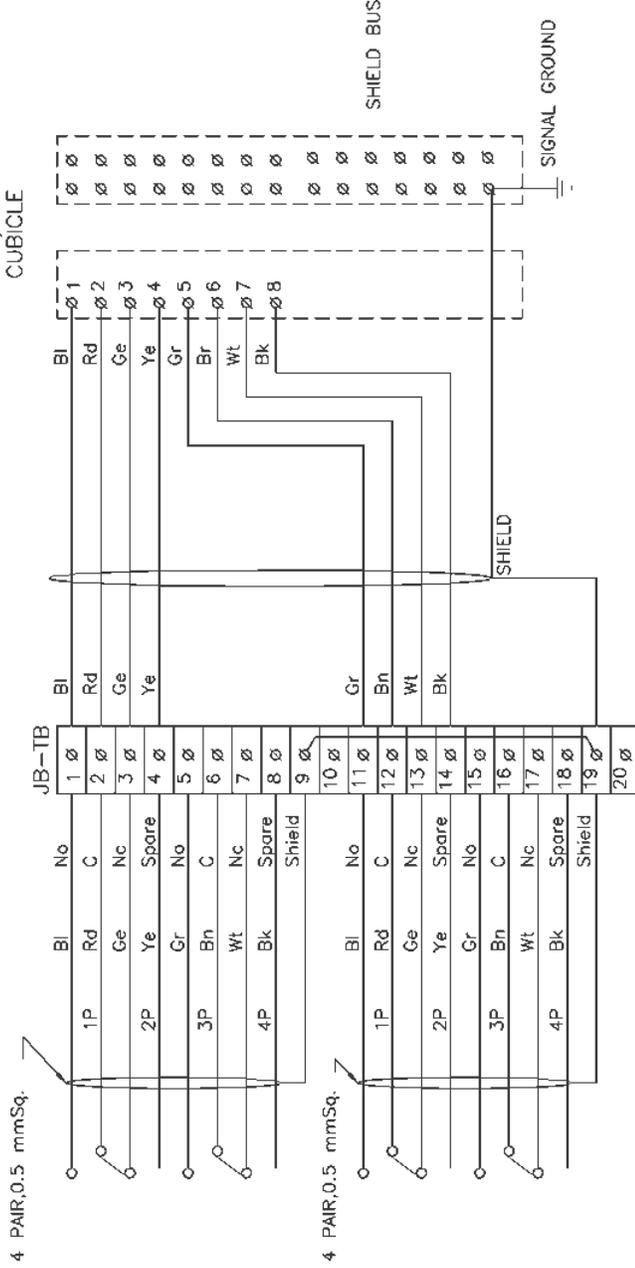
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नेशनल थर्मल पावर कॉर्पोरेशन लिमिटेड  
 National Thermal Power Corporation Ltd.  
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 ENGINEERING DIVISION

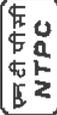
PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INTERFACING OF ACTUATORS	
REV. NO.	D	DRG. NO.	0000-999-POI-A-063
FIRST ISSUE	D	SCALE	N.T.S.
DATE	21.08.12	SIZE	A3
APPRO		DATE	
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Page 350 of 525 CLEARED BY			

MARSHALLING/TERMINATION CUBICLE

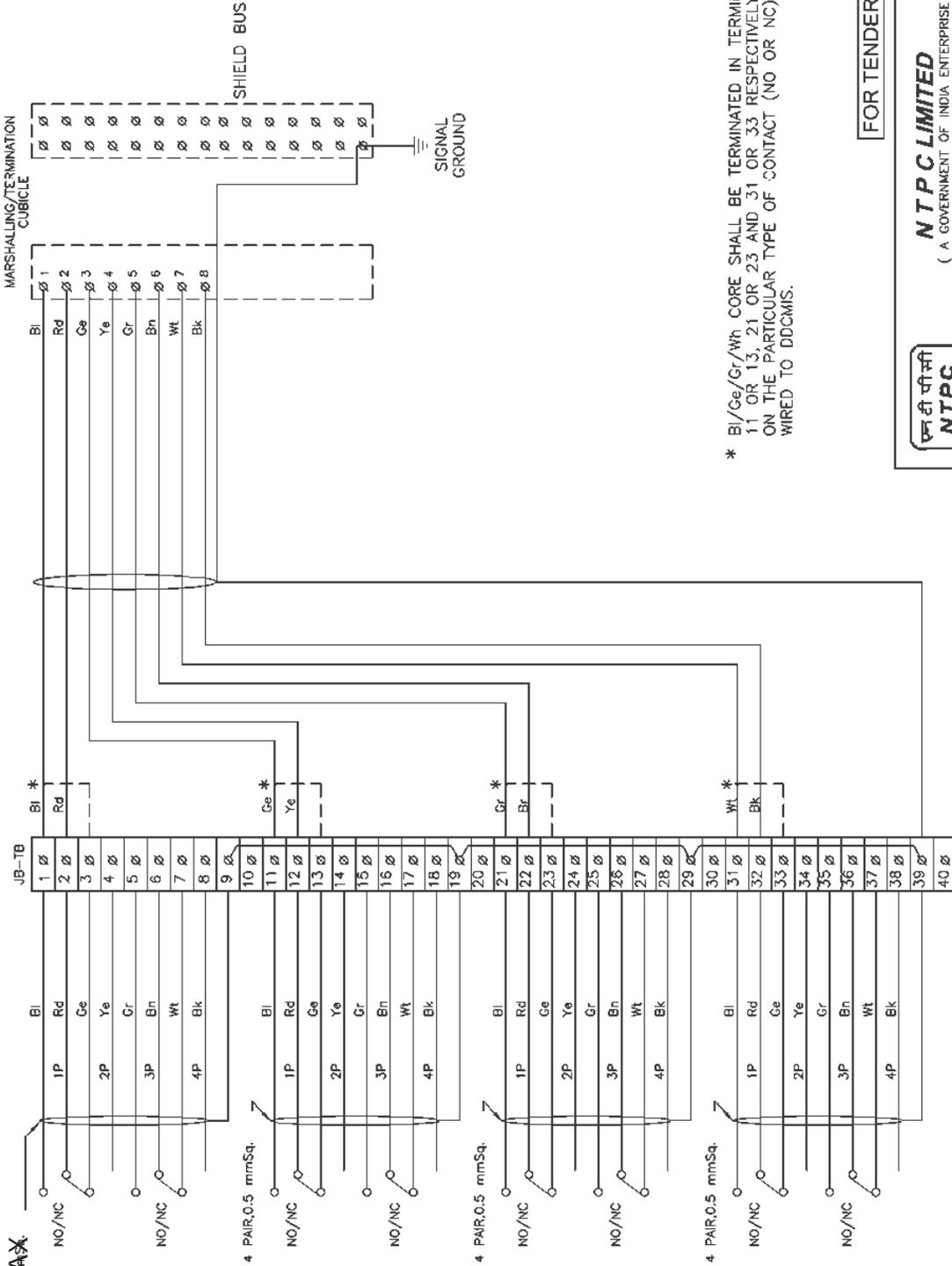


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FOR TENDER PURPOSE ONLY

		<b>NTPC LIMITED</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION	
PROJECT: TYPICAL THERMAL POWER PROJECT			
TITLE: INTERFACING OF FIELD INSTRUMENTS/ SWGR SWITCH (COC) TERMINATION DETAILS			
REV. NO.	SIZE	SCALE	DRG. NO.
A	A3	NTS	0000-999-POI-A-065
FIRST ISSUE	DATE	APPO	REV. NO.
	21.08.12		A
DESCRIPTION	CHKD.	ARCH.	SH 01 OF 15
		Page 351 of 525	
		CLEAR BY	

51296/2020/PS-PEM-DMA



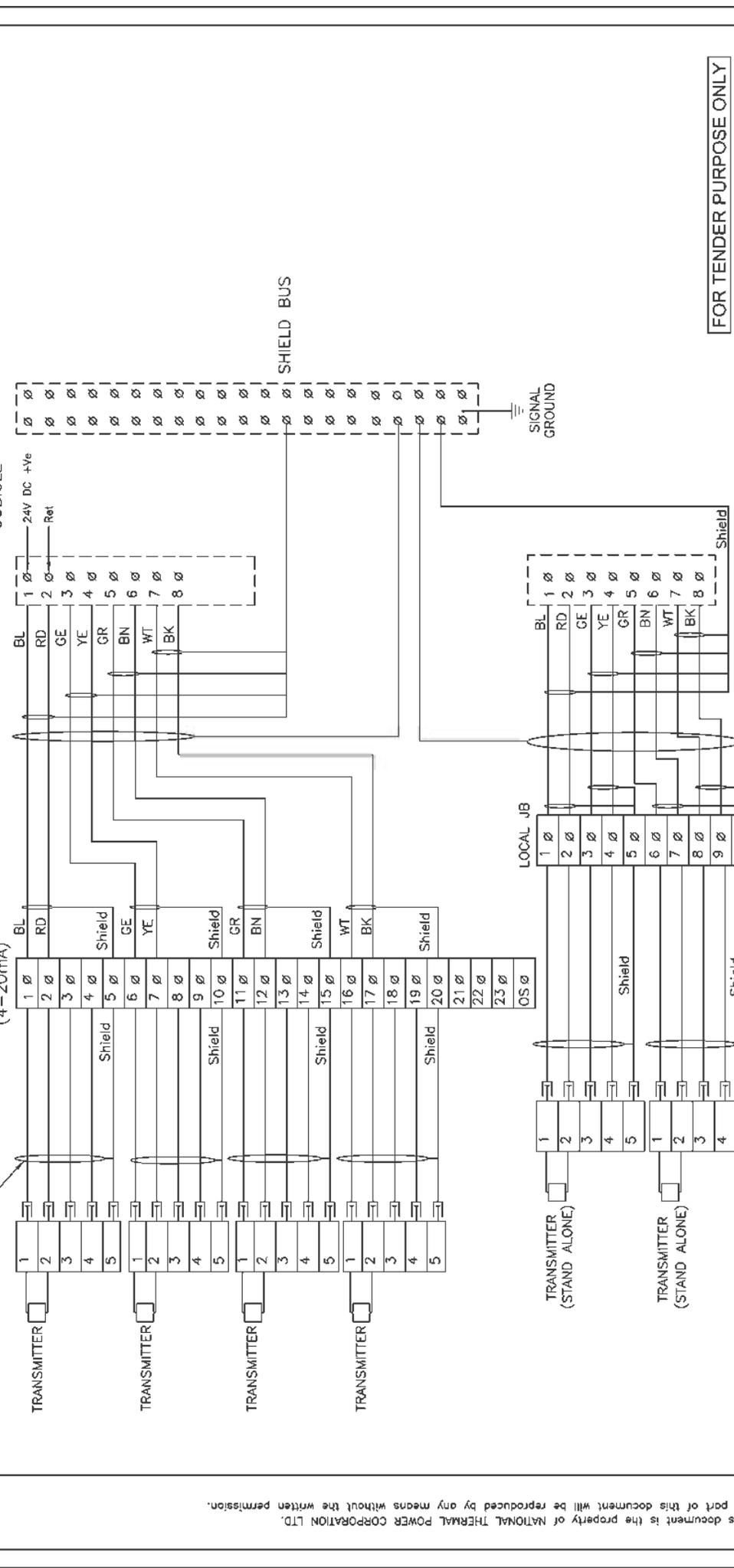
\* Bl/Ge/Gr/Wt CORE SHALL BE TERMINATED IN TERMINAL 1 OR 3, 11 OR 13, 21 OR 23 AND 31 OR 33 RESPECTIVELY DEPENDING ON THE PARTICULAR TYPE OF CONTACT (NO OR NC) IS TO BE WIRED TO DDCMIS.

FOR TENDER PURPOSE ONLY



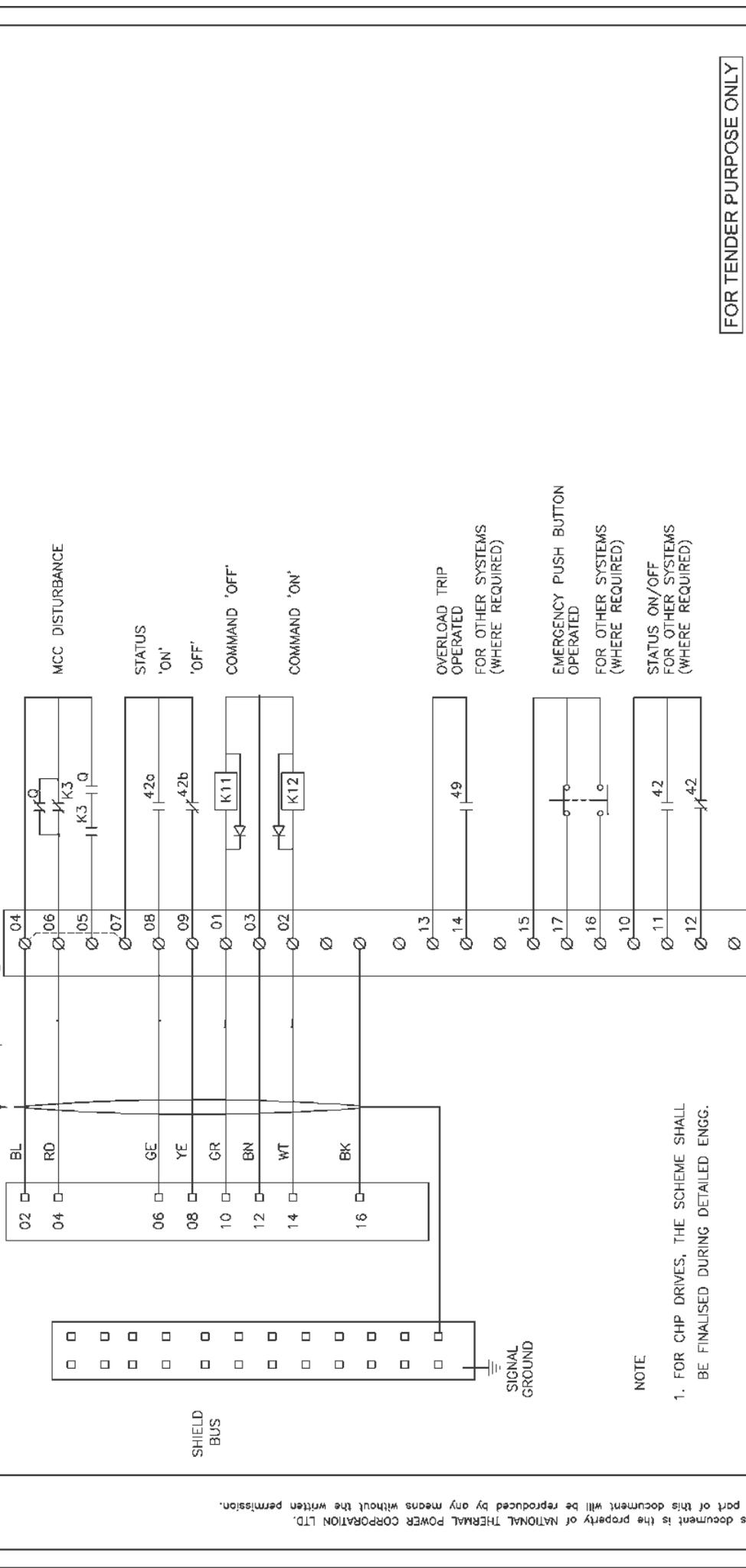
**NTPC LIMITED**  
( A GOVERNMENT OF INDIA ENTERPRISE )  
ENGINEERING DIVISION

PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INTERFACING OF FIELD INSTRUMENTS SWITCH TERMINATION DETAILS NO/NC	
REV. NO.	A	DRG. NO.	0000-999-POI-A-065
SCALE	NTS	SH	02 OF 15
DATE	21.08.12	APPD	
ARCH.		C&I	
C		E	
M		Page 352 of 525	
CHKD.		DESIGN	
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DESCRIPTION			
FIRST ISSUE			



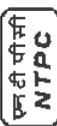
		<b>NTPC LIMITED</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION	
PROJECT			
TYPICAL THERMAL POWER PROJECT			
TITLE			
INTERFACING OF FIELD INSTRUMENTS 4-20mA			
REV. NO.	DRG. NO.	SCALE	REV. NO.
A	0000-999-POI-A-065	NTS	B
DESCRIPTION		SIZE	SH 04 OF 15
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FIRST ISSUE		DATE	
		21.08.12	
DRAWN		APPRO	
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CHKD.		ARCH.	
M		C&I	
E		C	
Page 353 of 525			
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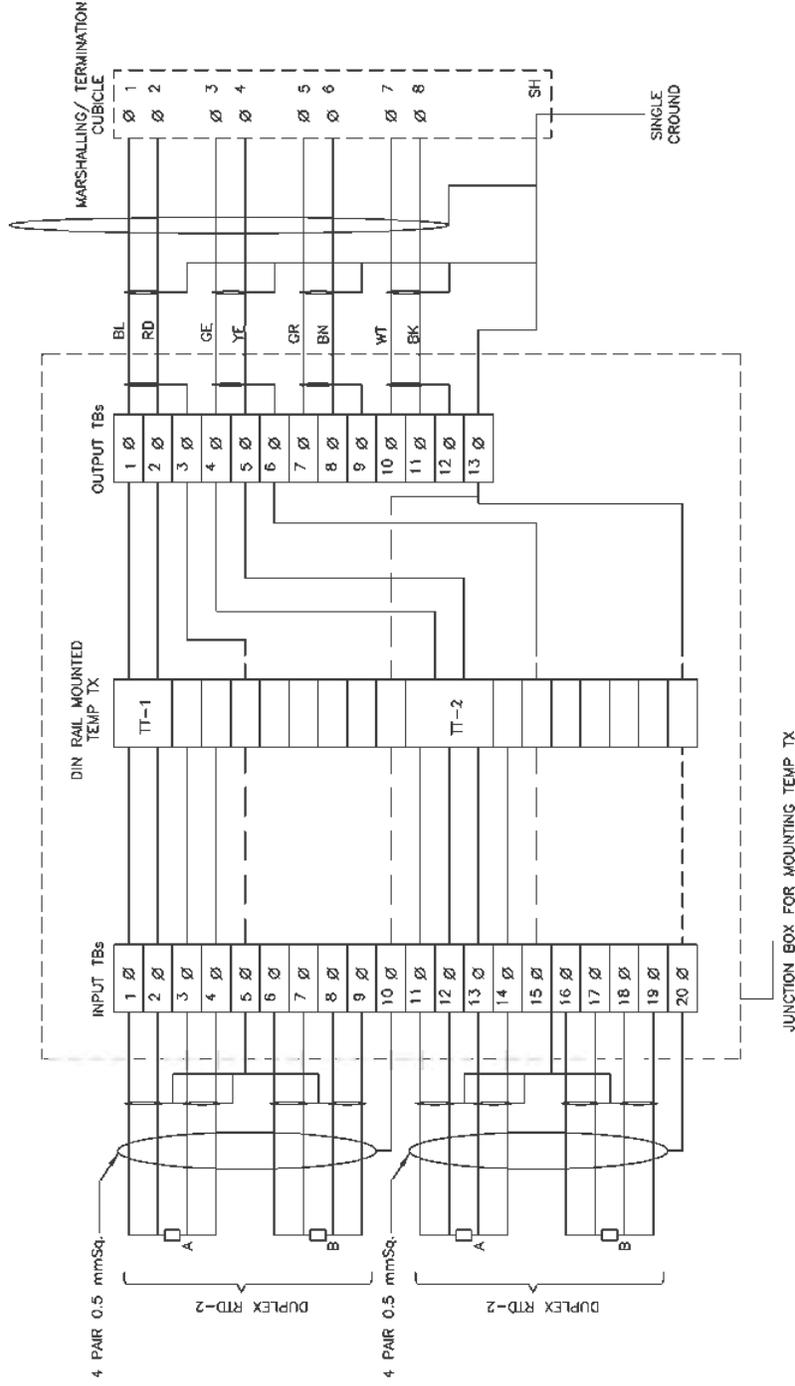
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NOTE  
 1. FOR CHP DRIVES, THE SCHEME SHALL BE FINALISED DURING DETAILED ENGG.

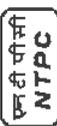
FOR TENDER PURPOSE ONLY

 <b>NTPC LIMITED</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION		PROJECT TYPICAL THERMAL POWER PROJECT	
TITLE INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (LT MOTORS)		SCALE NTS	DRG. NO. 0000-999-POI-A-065
REV. NO. A	DATE 21.08.12	SIZE A3	REV. NO. A
DESCRIPTION Page 354 of 525 CLEARED BY		APPD DATE	ARCH. C&I C E M



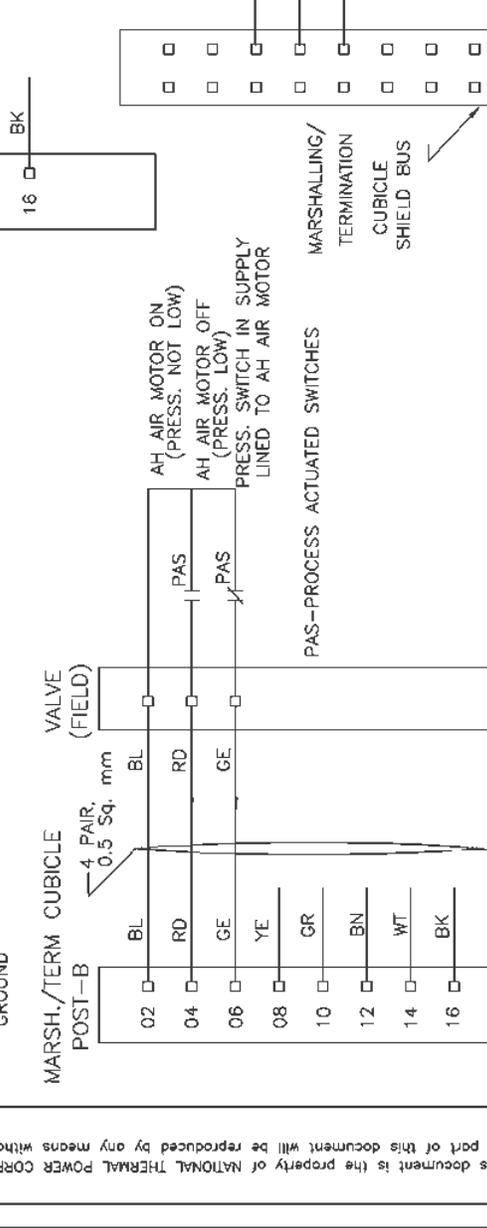
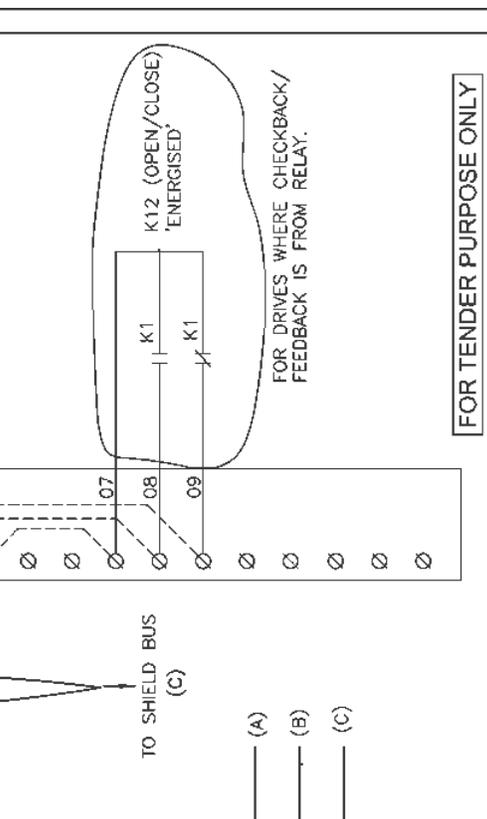
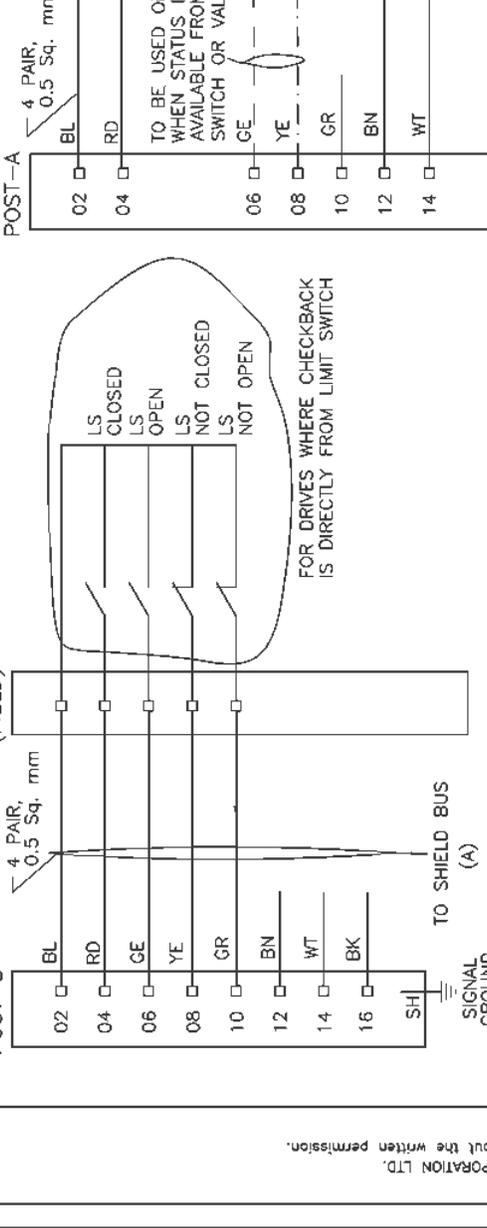
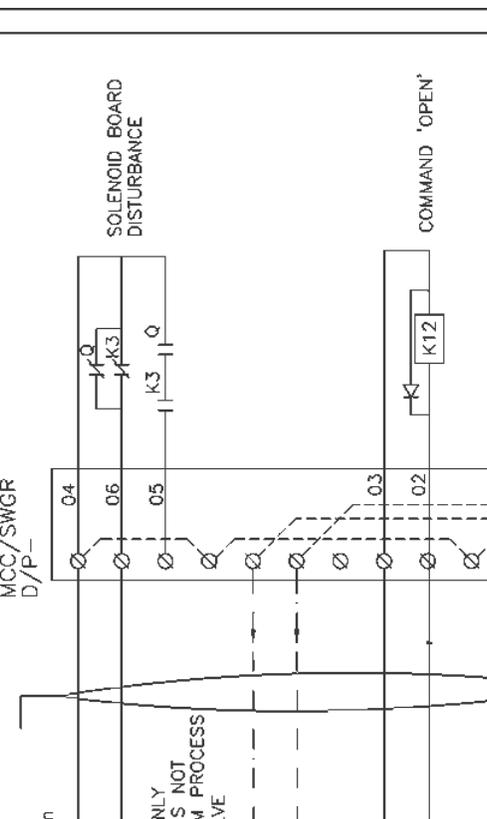
NOTE :- 1) ABOVE IS THE TYP. DRG. MOUNTED TEMP TRANSMITTER FRO T/C APPLICATION. EXACT TYPE OF TEMP TRANSMITTERS SHALL BE AS PER PART-A OF SPECIFICATION.  
 2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINISHED DURING DETAILED ENGG. STAGE.  
 3) PLEASE NOTE THAT THIS CONFIGURATION IS SHOWN FOR SINGLE INPUT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

FOR TENDER PURPOSE ONLY

 <b>NTPC LIMITED</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION		PROJECT TYPICAL THERMAL POWER PROJECT	
TITLE INTERFACING OF FIELD INSTRUMENTS TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS IN JBS		DATE 21.08.12	DRG. NO. 0000-999-POI-A-065
REV. NO. A	SCALE NTS	SIZE A3	REV. NO. A
DESCRIPTION D E S C R I P T I O N		APPD ARCH.	SH 06 OF 15

Page 355 of 525  
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51296/2020/POST-TERM-CUBICLE MARSH./TERM CUBICLE VALVE (FIELD) MARSH./TERM CUBICLE POST-A 4 PAIR, 0.5 Sq. mm



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

**FOR TENDER PURPOSE ONLY**

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (SINGLE COIL SOLENOID)

DATE: 21.08.12

APPROVED BY: [Signature]

SCALE: NTS

SIZE: A3

DRG. NO.: 0000-999-POI-A-065

REV. NO.: A

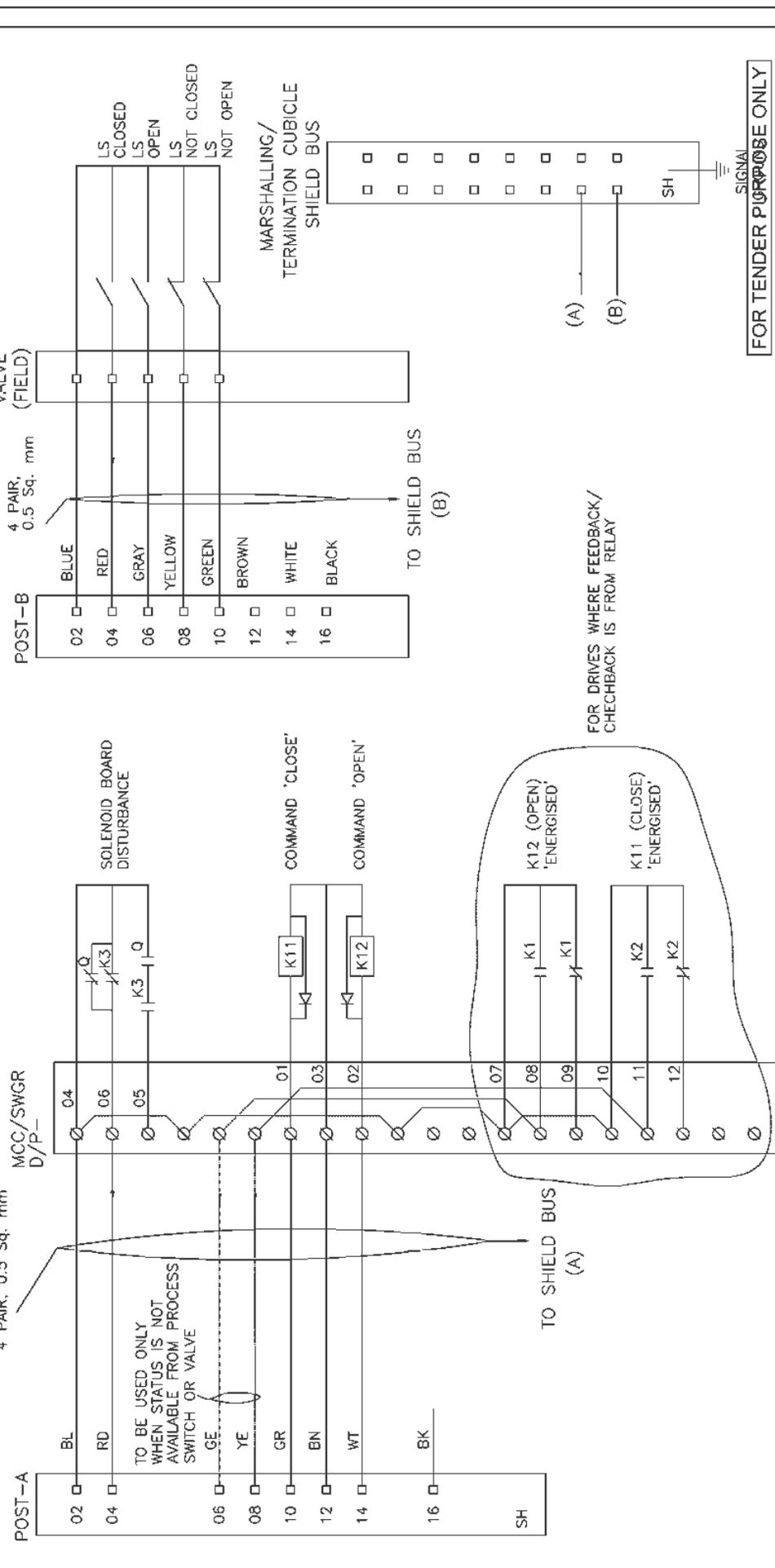
SH 08 OF 15

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPROVED	DATE
A	FIRST ISSUE	[Signature]									21.08.12

Page 356 of 525  
CLEARED BY: [Signature]

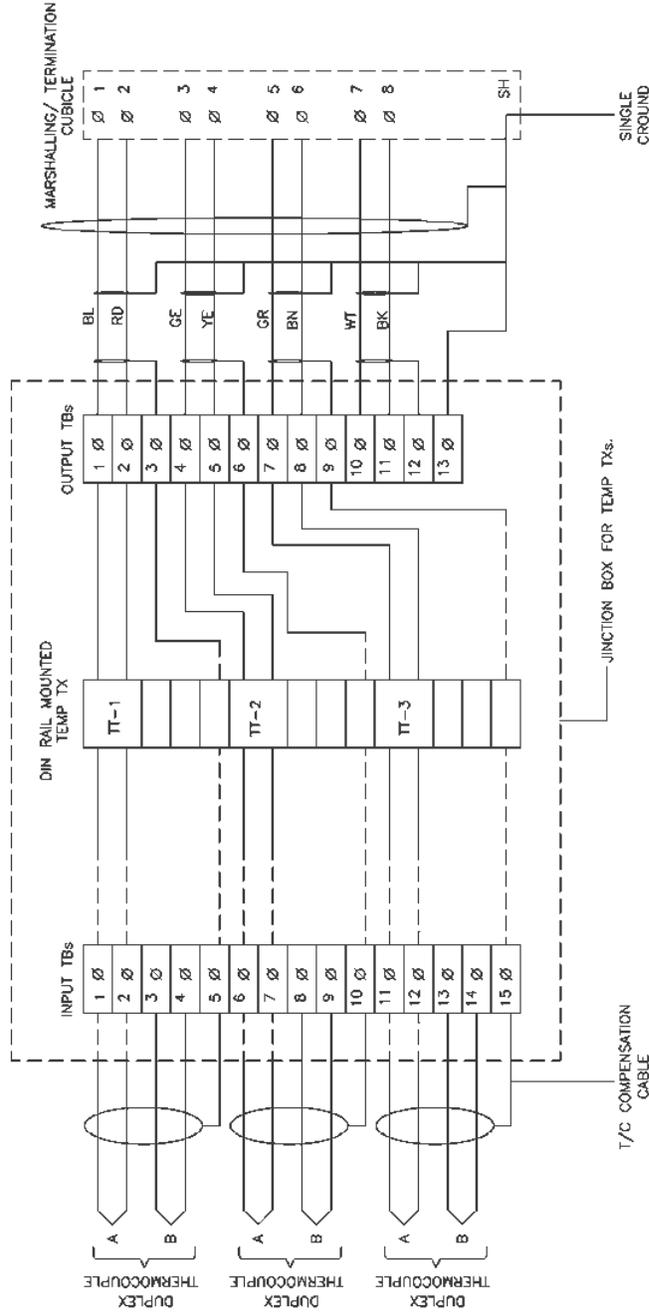
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51296/2020/SSP/NTPC/MAX  
 TERMINATION CUBICLE



**FOR TENDER PURPOSE ONLY**

<b>NTPC LIMITED</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION		<b>TYPICAL THERMAL POWER PROJECT</b>	
<b>PROJECT</b>		<b>TITLE</b>	
INTERFACE OF DDCMIS/PLC WITH MCC/SWGR/ACTUATOR (DOUBLE COIL SOLENOIDS)		21.08.12	
SIZE A3	SCALE NTS	DATE	ARCH.
DRG. NO. 0000-999-POI-A-065		APPRO	CHKD.
REV. NO. A		DESIGN	
SH 09 OF 15		DRAWN	
0000-999-POI-A-065		BY	
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SH 09 OF 15		CHKD.	
0000-999-POI-A-065		DESIGN	



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

FOR TENDER PURPOSE ONLY



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

PROJECT		TYPICAL THERMAL POWER PROJECT	
TITLE		INTERFACING OF FIELD INSTRUMENTS TYPICAL T/C CONNECTION WITH TEMP TXs IN JBS	
REV. NO.	DATE	SCALE	DRG. NO.
B	21.08.12	NTS	0000-999-POI-A-065
A	29.04.06	A3	SH 15 OF 15
DESCRIPTION		REV. NO. B	
DRAWN DESIGN		CHKD.	
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**C&I SPECIFICATION FOR  
HVAC SYSTEM**

SECTION: C  
SUB SECTION: C&I

**QUALITY ASSURANCE-INSTRUMENTS,  
LCP & TYPE TEST REQUIREMENTS**

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

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION											
MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)												
TESTS  ITEMS												
	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box	Y	Y	Y	Y				Y				
16. Orifice plate(BS-1042)	Y	Y	Y	Y*	Y	Y**	Y**		Y	Y**	Y	
17. Flow nozzle(BS-1042)	Y	Y	Y	Y*	Y	Y	Y		Y	Y	Y	
18. Impact head type element	Y	Y	Y				Y				Y	
19. Level transmitter/float type switch	Y	Y	Y	Y				Y	Y	Y	Y	
20. Analysers	Y	Y	Y	Y								
21. Dust emission monitors	Y	Y	Y	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.												
** If applicable												
R-Routine Test      A- Acceptance Test      Y – Test applicable												
Note: 1) Detailed procedure of Environmental Stress screening test shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.												

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION																	
Process, Connection & piping FOR C&I SYSTEMS																		
TESTS	ITEMS	Visual ⊕	GA, BOM, Layout of component & construction features⊕	Dimension ⊕	Paint Shade/thickness ⊕	Flattening, flaring, hydrotest, hardness check as per ASTM standard	Component Ratings ⊕	Wiring ⊕	Make, Model, Type, Rating⊕	IR & HV ⊕	Review of TC for instrument/devices (R)	Accessibility of TBs/Devices ⊕	Illumination,grounding ⊕	Tubing ⊕	Leak/Hydro test(A)	Chemical/physical properties of material (A)	Proof pressure test,Dismantling & reassembly test,Hydraulic impulse and vibration test (R)	Tests as per standards & specification
	Local Instrument enclosure	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y				
	Local instruments racks	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y				
	Junction Box	Y	Y	Y	Y *		Y		Y	Y								
	Gauge Board	Y	Y	Y	Y		Y		Y		Y			Y	Y			
	Impulse pipes and tubes	Y		Y		Y			Y							Y		
	Socket weld fittings ANSI B-16.11	Y		Y					Y							Y		Y
	Compression fittings	Y		Y					Y						Y	Y	Y	
	Instrument valves & Valve manifolds	Y		Y					Y						Y	Y		
	Copper tubings ASTM B75	Y							Y									Y
<p>*-applicable for painted junction boxes.</p> <p>Note: R-Routine Test                      A- Acceptance Test                      Y – Test applicable</p> <p>Note: This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.</p>																		
FLUE GAS DESULPHURISATION SYSTEM PACKAGE				TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC. NO CS-0011-109(1A)-2					SUB-SECTION-V-QC2 PROCESS CONNECTION PIPING					PAGE 1 OF 1				

CLAUSE NO.		QUALITY ASSURANCE & INSPECTION										एनटीपीसी NTPC				
<b>INSTRUMENTATION CABLE</b>																
TESTS	ITEMS	Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheath/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity. at room & Elevated Temp. (A) ++	Spark test report review ®
<b>1. Instrument cable twisted and shielded</b>																
Conductor(IS-8130)		Y			Y		Y									
Insulation(VDE-207)					Y	Y	Y	Y						Y		Y
Pairing/Twisting					Y	Y	Y									
Shielding					Y		Y			Y						
Drain wire		Y			Y		Y		Y	Y						
Inner Sheath					Y	Y	Y	Y					Y	Y		
Outer Sheath					Y	Y	Y	Y					Y	Y		
Over all cable		Y	Y	Y	Y	Y	Y	Y	Y		Y				Y	
Cable Drums(IS-10418)					Y		Y									
<p><b>Note :</b> High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.</p> <p><b>Note :</b> This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice &amp; Procedure along with relevant supporting documents during QP finalization for all items.</p> <p><b>Note :</b> ® - Routine Test A - Acceptance Test Y - Test Applicable</p> <p><b>Note :</b> Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)</p> <ul style="list-style-type: none"> <li>* FRLS Tests: Oxygen / Temp Index ( ASTM D-2863), Smoke Density Rating ( ASTM – D 2843), HCL Emission ( IEC-754-1)</li> <li>** Characteristic Impedance, Attenuation, Mutual Capacitance, Cross Talk ( As applicable)</li> </ul> <p>+ Sample size will be One No. of each size/type per lot.</p> <p>++ Sample size will be One No. sample for complete lot offered irrespective of size/type.</p>																
FLUE GAS DESULPHURISATION SYSTEM PACKAGE				TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC. NO CS-0011-109(1A)-2				SUB-SECTION-V-QC3 INSTRUMENTATION CABLES				PAGE 1 OF 1				

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION														एनटीपीसी NTPC	
CONTROL DESK, PLC PANEL, SMOKE DETECTOR, FIRE ALARM & CONTROL SYSTEM																
ITEMS	TESTS															
	Visual ®	GA, BOM ,Lay Out of components ®	Dimensions ®	Paint Shade/Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ osatic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element	Mimic ®	Test as per IEC 1131 ® *	Test as per Std ® & ( A)	
	1. Control Desk	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
	2. Annunciation/ Control/ PLC Panel	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y
3.Smoke Detectors ( UL-268,EN-54 PT-7), Heat Detectors( UL-521/EN 54 PT-5 ) Annunciation/ Control Panel ( UL -864, EN-54, PT-2)														Y		
<p><b>Note:</b> 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions</p> <p>2) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents.</p> <ul style="list-style-type: none"> <li>*Applicable for PLC</li> <li>Y - Test Applicable , ® - Routine Test (A) - Acceptance Test</li> </ul>																
FLUE GAS DESULPHURISATION SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION - VI, PART-B BID DOC. NO CS-0011-109(1A)-2				SUB-SECTION-V-QC4 CONTROL DESK, PLC PANEL, SMOKE DETECTOR, FIRE ALARM & CONTROL SYSTEM				PAGE 1 OF 1							



CLAUSE NO.	QUALITY ASSURANCE & INSPECTION			
<b>VFD MODULE SQE_28</b>				
<b>ATTRIBUTES / CHARACTERISTICS</b>	Visual & Dimensional checks	Make / Type / Rating etc.	Final Inspectio n as ISS / IEC	Remarks
<b>ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY</b>				
HT Breaker (IEC 56)	Y	Y	Y	
DC Reactor	Y	Y		For details refer table for DC Reactor
Transformer	Y	Y		For details refer table for Transformer
Motor	Y	Y		For details refer separate table for Motor
VFD Panel	Y	Y		For details refer table for VFD
<p>Note : 1) This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices &amp; Procedure followed alongwith relevant supporting documents during QP finalisation.</p> <p>2) Make of all major Bought Out Items will be subject to NTPC approval.</p>				
LOT-IA PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC. NO CS-0011-109(1A)-2		SUB-SECTION-V-QE13 VFD MODULE	PAGE 1 OF 5

CLAUSE NO.		QUALITY ASSURANCE & INSPECTION							एनटीपीसी NTPC
<b>DC REACTOR</b>									
<b>ATTRIBUTES / CHARACTERISTICS</b>									
<b>ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY</b>	Visual	Dimensional	Mech. & Chem. Property	Electrical Characteristics	Pretreatment by Seven Tank	Painting by Stove Enameling	Final Inspection as per IS-2026	Welding/NDT	
Winding Material (Aluminium)	Y	Y	Y	Y					
Insulation Material	Y	Y		Y					
Sheet Steel	Y	Y	Y						
Winding	Y	Y		Y					
Fabrication of Enclosures	Y	Y			Y	Y		Y	
Assembly	Y	Y							
Routine Tests	Y	Y					Y		
<p>Note : 1) This is an indicative list of tests/checks. The manufacturer to furnish a detailed Quality Plan indicating their practice &amp; procedure along with relevant supporting documents during QP finalisation for all items.</p> <p>2) All major Bought Out Items will be subject to NTPC approval.</p>									
LOT-IA PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE			TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC. NO CS-0011-109(1A)-2			SUB-SECTION-V-QE13 VFD MODULE		PAGE 2 OF 5	

CLAUSE NO.		QUALITY ASSURANCE & INSPECTION												
TRANSFORMER (OIL FILLED)														
Attributes / Characteristics	Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	WPS & PQR	Routine Test as per relevant test	Routine Test
	Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y						
	Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
	Copper Conductor (IS:191)	Y	Y	Y		Y								
	Insulating Material	Y	Y	Y	Y	Y	Y							
	CRGO Lamination & Built Core	Y	Y	Y		Y	Y							
	Bushing / Insulator ( IS:2544 / 5621)	Y	Y								Y		Y	
	Gasket	Y				Y	Y		Y				Y	
	Transformer Oil ( IS:335 / IEC296)												Y	
	Off-Circuit Tap Changer	Y									Y			
	Core Coil Assembly & Pre-tanking	Y								Y				
	Marshalling Box	Y	Y					Y					Y	
	WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Globe & Gate Valve,	Y									Y			
	Welding (ASME Sect-IX)	Y										Y		
	Complete Transformer (IS:2026/ IEC-60076)	Y												Y
<p>Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents. 2) All major Bought Out Items will be subject to NTPC approval.</p>														
LOT-IA PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE					TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC. NO CS-0011-109(1A)-2					SUB-SECTION-V-QE13 VFD MODULE			PAGE 3 OF 5	

CLAUSE NO.	TECHNICAL REQUIREMENTS		
<b>TYPE TEST REQUIREMENTS</b>			
1.00.00	<b>TYPE TEST REQUIREMENTS</b>		
1.01.00	General Requirements		
1.01.01	<p>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&amp;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.</p> <p>(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.</p> <p>(b) For the rest, submission of type test results and certificate shall be acceptable provided.</p> <p style="padding-left: 40px;">i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment.</p> <p style="padding-left: 40px;">ii. There has been no change in the components from the offered equipment &amp; tested equipment.</p> <p style="padding-left: 40px;">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.</p> <p>(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.</p>		
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.		
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	<b>SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS</b>		
2.01.00	<p>The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&amp;I systems Analyzer instruments, various PLCs etc. shall be as indicated below:</p> <p>i) Surge Protections for Solid State Equipments/ Systems</p> <p>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 &amp; output modules, Binary input &amp; 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.</p> <p>ii) Dry Heat test as per IEC-68-2-2 or equivalent.</p> <p>iii) Damp Heat test as per IEC-68-2-3 or equivalent.</p> <p>iv) Vibration test as per IEC-68-2-6 or equivalent.</p> <p>v) Electrostatic discharge tests as per IEC 61000-4-2 or equivalent.</p> <p>vi) Radio frequency immunity test as per EN 50082-2 or equivalent.</p>		
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			
	<p>vii) Electromagnetic immunity as per EN 61131-2 or equivalent.</p> <p>Test listed at item no. v, vi, vii, above are applicable for front end cards only as defined under item (i) above.</p>			
<p>FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-III-C6 TYPE TEST REQUIREMENTS</p>	<p>PAGE 3 OF 7</p>	

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3.00.00 TYPE TEST REQUIREMENT FOR C&I SYSTEMS

Sl No	Item	Test requirement	Standard	Test to be specifically conducted	NTPC's approval req. On test certificate	Remarks
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
1	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes	
2	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes	
3	INSTRUMENTATION CABLES TWISTED & SHIELDED					
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.: 09-S-303 of 169(A)-2	SUB-SECTION-III-C6 TYPE TEST REQUIREMENTS	PAGE 4 OF 7
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SI No	Item	Test requirement	Standard	Test to be specifically conducted	NTPC's approval req. On test certificate	Remarks
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
11	Junction Box	Degree of protection test	IS-13947	No	Yes	
12	Battery charger (Not required for inbuilt chargers)	Degree of protection test	IS-13947	No	No	
		Short circuit current capability	IEC-60146-2	No	Yes	
		Temp rise test without redundant fans	Approved procedure, IEC 60146-2	No	Yes	
		SWC test	Approved procedure	No	Yes	
		Burn-in-test	Approved procedure	No	Yes	
		Efficiency	IEC-60146-2,	No	Yes	
		Audible Noise Test	IEC 60146-2	No	Yes	
		Fuse Clearing Capability	Approved procedure	No	Yes	
		Relative harmonic content	Approved procedure	No	Yes	

LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: 09S-384 of 1691A-2	SUB-SECTION-III-C6 TYPE TEST REQUIREMENTS	PAGE 6 OF 7
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SI No	Item	Test requirement	Standard	Test to be specifically conducted	NTPC's approval req. On test certificate	Remarks
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
		ESD immunity test	IEC-61000-4-2-9(1)	No	Yes	
		Radio interference	IEC 60146-2	No	Yes	
		Over Load Test on Inverter & charger	Approved procedure	No	Yes	
		Restart Test	IEC 60146-2	No	Yes	
		Output voltage tolerance	Approved	No	Yes	
		Output voltage Harmonic content	Approved procedure	No	Yes	
		Insulation test	IEC 60146	No	Yes	
		Load Tests	Approved procedure	No	Yes	
		Preliminary light load test	IEC 60146	No	Yes	
		Current division / Voltage division	IEC 60146-2	No	Yes	
13	Battery	As per standard (col 4)	IEC -623 / IS 10918 for Ni-Cd IS-1652 for Plante Lead Acid	No	Yes	
14	Voltage stabilizers	Over Load Test	Approved procedure	No	Yes	

LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: 09S-385 of 525 1691A12	SUB-SECTION-III-C6 TYPE TEST REQUIREMENTS	PAGE 6 OF 7
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SI No	Item	Test requirement	Standard	Test to be specifically conducted	NTPC's approval req. On test certificate	Remarks
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
		Temp rise test without redundant fans	Approved procedure	No	Yes	

LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: <del>99-386</del> <b>1-1691A</b> -2	SUB-SECTION-III-C6 TYPE TEST REQUIREMENTS	PAGE 7 OF 7
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**C&I SPECIFICATION FOR  
HVAC SYSTEM**

SECTION: C  
SUB SECTION: C&I

**SUB VENDOR LIST**

## PACKAGE WISE REGISTERED SUPPLIER LIST (PERMANENT CATEGORY) AS ON 7/23/2020 11:12:30 AM

SI No	Package Name	Supplier Name	Supplier Communication Address
1	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Singhgad Road, Vadgaon Khurd, Near Ldkmat Press, Pune, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,
2	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone-9999464663 Pincode : 382729 Email : sales@precisionmass.com
3	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Javaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in
4	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroffindia.com
5	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone-09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
6	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dom Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de
7	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
8	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : miktg@indfos.com
9	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adiwave Towers, Dr.Sevalia Shivaji Salaj, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
10	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone-24757784,22472509 Pincode : 700020 Email : anide@bol.net.in
11	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net
12	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
13	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
14	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR.SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
15	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone-9999464663 Pincode : 382729 Email : sales@precisionmass.com

16	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
17	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
18	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 98922230623, Pincode : 400 701, Email : sdbpl@vsnl.com
19	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone-9920576002 Pincode : 396105 Email : sales@nesstech.co.in
20	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
21	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
22	TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
23	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT - B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtlworks@pyro-electric.in
24	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone-24757784,22472509 Pincode : 700020 Email : antide@bol.net.in
25	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR.SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARANI, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
26	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@gainstruments.com,
27	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone-9999464663 Pincode : 382729 Email : sales@precisionmass.com
28	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
29	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone-441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
30	LEVEL GAUGE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B, IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
31	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	Gopal Kanna/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
32	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV,INDUSTIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com

33	TEMP. ELEMENT	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in
34	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema, Mahim Mumbai Phone- 09322664709 Pincode : 400016 Email : rnmk@giconindia.com
35	TEMP. ELEMENT	Tempensens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempensens.com
36	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Wantiyani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
37	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	M. D. BICHU/R. M. BICHU G.B. HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA Phone- 9326114601 Pincode : 403507 Email : priyanika.marketing@pyro-electric.in
38	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
39	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goinstruments.com,
40	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhapura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tjpl.com,
41	TEMP. ELEMENT	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892220623, Pincode : 400 701, Email : sdbpl@vsnl.com
42	TRANSMITTERS	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/MR. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810003826 Pincode : 110 020 Email : sales@vautomat.com
43	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatau/Sudhakar Badiger S-18, MIDC Bhosani, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
44	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com
45	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business, Parisiwada, Sahar road, Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
46	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,
47	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhapura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tjpl.com,
48	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
49	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,

50	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@mininet.com
51	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com
52	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
53	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankt.varshney@siemens.com
54	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@deliby.rpgms.ems.vsnl.net.in
55	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com
56	TEMPERATURE SWITCH	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
57	TEMPERATURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com
58	TEMPERATURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRAMAN/MR.B.KANNAN New No.17, II Floor, Adwawe Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone -+91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
59	TEMPERATURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V.S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in
60	TEMPERATURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@soninc.com, avdhesh@sherman-india.com,
61	DIFFERENTIAL PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@soninc.com, avdhesh@sherman-india.com,
62	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net
63	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com
64	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27837, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
65	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sump.com
66	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG ,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com

67	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
68	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAMY K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
69	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
70	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moothalaj/Mayur Rajput.J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
71	LEVEL SWITCH-CAPACITANCE TYPE	SIGMA INSTRUMENTS CO.	Gopal Kamnan/R Gopinath 201- ANANDRAJ INDUSTRIAL ESTATE, OFF LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
72	LEVEL SWITCH-CAPACITANCE TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL-AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
73	LEVEL SWITCH-CAPACITANCE TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
74	LEVEL SWITCH-CAPACITANCE TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosani, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
75	LEVEL SWITCH-CAPACITANCE TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
76	LEVEL SWITCH-CAPACITANCE TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
77	LEVEL SWITCH-CONDUCTIVITY TYPE	Sapcon Instrument Pvt Ltd.	131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.com
78	LEVEL SWITCH-CONDUCTIVITY TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
79	LEVEL SWITCH-CONDUCTIVITY TYPE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124- 4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
80	LEVEL SWITCH-CONDUCTIVITY TYPE	HI-TECH SYSTEMS & SERVICES LTD.	Mr. Vikash Agrawal/Mr. Tarun Debmath 119, PARK STREET , KOLKATA Phone- 033- 22290045 Pincode : 700016 Email : sandeep@hitech.in
81	LEVEL SWITCH-CONDUCTIVITY TYPE	RAMAN INSTRUMENTS PVT.LTD.	Mr. N R Shenoy/Mr. G B Vijh 8, First Floor,Plot : 160A Bait-Ush-Sharaf, 29th Road,Bandra(W) MUMBAI Phone- 09892331381 Pincode : 400050 Email : ramanbpl@vsnl.com
82	LEVEL SWITCH-CONDUCTIVITY TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL-AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
83	LEVEL SWITCH-CONDUCTIVITY TYPE	SIGMA INSTRUMENTS CO.	Gopal Kamnan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in

84	LEVEL SWITCH-CONDUCTIVITY TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone-09810905139, Pincode : 66215 Email : Ldegarmo@soninc.com, avdhesh@sherman-india.com,
85	LEVEL SWITCH-FLOAT TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatani/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
86	LEVEL SWITCH-FLOAT TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL-AREA, PH-1 NEW DELHI Phone-9810005826 Pincode : 110 020 Email : sales@vautomat.com
87	LEVEL SWITCH-FLOAT TYPE	D.K. INSTRUMENTS PVT.LTD.	N.SIKDAR/ SUMIT SIKDAR 76/2,SELLIMPUR RD DHAKURIA Kolkata Phone- 033-2415-1310. Pincode : 700031 Email : dkinst@vsnl.net
88	LEVEL SWITCH-FLOAT TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
89	LEVEL SWITCH-FLOAT TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badai Jana Rajkamal, 7th floor, 13, Camac Street KOLKATA Phone- 033 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
90	LEVEL SWITCH-FLOAT TYPE	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
91	LEVEL SWITCH-FLOAT TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Wariani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
92	LEVEL SWITCH-FLOAT TYPE	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
93	LEVEL SWITCH-FLOAT TYPE	SIGMA INSTRUMENTS CO.	Gopal Kamran/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
94	LEVEL SWITCH-FLOAT TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone-09810905139, Pincode : 66215 Email : Ldegarmo@soninc.com, avdhesh@sherman-india.com,
95	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAW/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone-9810182430 Pincode : 110048 Email : niraj@aurainc.com
96	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAMY K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
97	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
98	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moothathai/Mayur Rajput.J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
99	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com
100	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahmani/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com

101	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwali,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
102	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
103	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
104	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santoshi@panamengineers.com,
105	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhalal/Mayur Rajput.J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
106	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
107	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
108	INSTRUMENT FITTINGS	Comfitr & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com

Notes:- 1.)The above Sub-Vendor list is tentative & reference only. However Sub-Vendor List is subject to BHEL/End user approval without any commercial /delivery implication. 2.)New Sub-Vendor if proposed by Vendor during contract stage shall subject to BHEL/end user approval without commercial/delivery implication.

	DOCUMENT TITLE
	<b>KKS NUMBERING PHILOSOPHY</b>

**KKS NUMBERING PHILOSOPHY**

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A	A	Y	Y	B	B	B
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First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

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KKS TAGS ARE PROVIDED IN THE P&ID FURNISHED BY VENDOR.HOWEVER, IF THE KKS NUMBER OF EQUIPMENT/INSTRUMENTS CHANGES,THE SAME SHALL BE FINALIZED DURING DETAILED ENGINEERING.

	DOCUMENT TITLE
	<b>KKS NUMBERING PHILOSOPHY</b>
<b>ANNEXURE-1</b>	
<b>List of System / Sub-System Codes used in Power Plant:</b>	
<p>1) Refer the P&amp;ID sheets.</p>	
<b>ANNEXURE-2</b>	
<b>Standard Equipment Codes:</b>	
AA AB AC AE AF AG AH AK AM AN AP AT AV	Valves including drives, also hand operated Seclusions, Lock, Gates, Doors Heat Exchanger Turning, Driving, Lifting equipment Continuous conveyors, Feeders Generator Units Heating and Cooling Units Pressing and Packaging equipment Mixer, Stirrer Blower, Air Pumps / Fans, Compressor Units Pump Units Purification, Drying, Filter Combustion Equipment e.g. grates
<b>Standard Apparatus Codes:</b>	
BB BF BG BN BP BQ BR BS BU	Vessels and Tank Foundation Boiler Heating Surfaces Injector, Ejector Flow and throughput limitation equipment (Orifice) Holders, Carrying Equipment, Support Piping, Ducts, Chutes, Compensator Sound Absorber Insulations, Sheatings
<b>Standard Measuring Circuits Codes:</b>	
CD CE CF CG CK CL	Density Electrical Quantities Flow, throughput Distance, Length, Position Time Level

	<p>DOCUMENT TITLE</p> <p style="text-align: center;"><b>KKS NUMBERING PHILOSOPHY</b></p>																					
<p>CM CQ CS CT CY</p>	<p>Humidity Analysis (SWAS) Speed, Velocity, Frequency Temperature Vibration, Expansion</p>																					
<p><b>ANNEXURE-3</b></p> <p><b>Numerical Keys</b></p> <p><b>A) Numerical Keys at System Code Level</b></p> <p>i) Use 10, 20, 30... To distinguish between main systems having same Alpha Codes. Examples:</p> <p style="margin-left: 40px;">a) Main Steam (Left) and Main Steam (Right)</p> <p style="margin-left: 40px;">b) BFP – A/B/C</p> <p style="margin-left: 40px;">c) ID Fan – A/B, FD Fan A/B, AH – A/B</p> <p>ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.</p> <p>iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.</p> <p><b>B) Numerical keys at Equipment Code level:</b></p> <p>There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.</p> <p>i) <b>Valves and Dampers --- Equipment Code – AA</b></p> <table border="0" style="margin-left: 40px;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>N1</u></th> <th style="text-align: center;"><u>N2</u> <u>N3</u></th> </tr> </thead> <tbody> <tr> <td>Motorised (<i>on/off duty</i>)</td> <td style="text-align: center;">0</td> <td style="text-align: center;">01 to 50</td> </tr> <tr> <td>Motorised (<i>inching duty</i>)</td> <td style="text-align: center;">0</td> <td style="text-align: center;">51 to 99</td> </tr> <tr> <td>Pneumatic (Control)</td> <td style="text-align: center;">1</td> <td style="text-align: center;">01 to 50</td> </tr> <tr> <td>Motorised (<i>thyrestor Control</i>)</td> <td style="text-align: center;">1</td> <td style="text-align: center;">51 to 99</td> </tr> <tr> <td>Sol. Operated (Open / Close duty (Valves, NRVs, Gate)</td> <td style="text-align: center;">2</td> <td style="text-align: center;">01 to 99</td> </tr> <tr> <td>Hydraulic</td> <td style="text-align: center;">3</td> <td style="text-align: center;">01 to 99</td> </tr> </tbody> </table>			<u>N1</u>	<u>N2</u> <u>N3</u>	Motorised ( <i>on/off duty</i> )	0	01 to 50	Motorised ( <i>inching duty</i> )	0	51 to 99	Pneumatic (Control)	1	01 to 50	Motorised ( <i>thyrestor Control</i> )	1	51 to 99	Sol. Operated (Open / Close duty (Valves, NRVs, Gate)	2	01 to 99	Hydraulic	3	01 to 99
	<u>N1</u>	<u>N2</u> <u>N3</u>																				
Motorised ( <i>on/off duty</i> )	0	01 to 50																				
Motorised ( <i>inching duty</i> )	0	51 to 99																				
Pneumatic (Control)	1	01 to 50																				
Motorised ( <i>thyrestor Control</i> )	1	51 to 99																				
Sol. Operated (Open / Close duty (Valves, NRVs, Gate)	2	01 to 99																				
Hydraulic	3	01 to 99																				

DOCUMENT TITLE	
<b>KKS NUMBERING PHILOSOPHY</b>	
NRV (Without actuation)	- 4 01 to 99
Manual	- 5 01 to 99
Manual	- 6 01 to 99
Relief & Safety Valves	- 7 01 to 99
Reserve	- 8 01 to 99
Reserve	- 9 01 to 99
<b>ii) Field Instruments</b>	
Field Transmitters & Analog Signals	- 0 01 to 99
Field Switches & Binary Signals	- 1 00 to 99
PG Test Point	- 4 00 to 99
Gauges	- 5 00 to 99
Automatic Turbine Tester (ATT)-HWR	- 2 00 to 99
(Reserved for protection Signals used by Hardwar)	
<b>Example of Numerical Key Usage:</b>	
<p>In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ..... Where system code is same.</p>	



**AIR CONDITIONING SYSTEM**

**LIST OF MAKES OF SUB-VENDOR ITEMS**

**LIST OF MAKES OF SUB-VENDOR ITEMS**



## AIR CONDITIONING SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

SLNo	ITEM	VENDOR
1	SCREW CHILLER	YORK
		TRANE
		CARRIER
		KIRLOSKAR
		DUNHAM BUSH
		MCQUAY (DAIKIN)
		BLUE STAR
		VOLTAS
2	CONDENSING UNIT	BLUE STAR
		CARRIER
		TRANE
		VOLTAS
3	PRECISION PACKAGE UNITS	STULZ
		UNIFLAIR
		EMERSON PROCESS MANAGEMENT (ROSEMOUNT)
		BLUEBOX
		CLIMADENTA
4	PACKAGE UNIT	VOLTAS
		BLUE STAR
		CARRIER
5	SPLIT AIR CONDITIONER	VOLTAS
		BLUE STAR
		CARRIER
		HITACHI-HIREL
		LG
6	AIR HANDLING UNITS	VOLTAS
		BLUE STAR
		ZECO
		CARRYAIRE (FLAKT)
		EDGETECH
		ETHOS
		SYSTEM AIR
		WAVES AIRCON
7	AHU FAN (CENTRIFUGAL FAN)	CB DOCTOR
		FLAKT
		KRUGER
		NICOTRA
		COMEFRI
		MARATHON
		PATEL AIR
		ADVANCE



## AIR CONDITIONING SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

		DRAFT AIR
		HYDERABAD POLLUTION
		SK SYSTEM
		SARLA
8	LV MOTORS (NON-FLAME PROOF)	SIEMENS
		ABB
		CGL
		MARATHON
		KEC
		BHARAT BIJLEE
		NGEF
		JYOTI
		LHP
		BHARAT ELECTRIC
9	AIR FILTER	PUROLATOR
		FMI
		ANFILCO
		TENACITY
		JOHN FOWLER
		SPECTRUM
		AIR TECH
		PUROMATIC
10	FRESH AIR/ SUPPLY/ EXHAUST/ RE UNIT FANS	FLAKT
		KHAITAN
		PATEL AIR
		NICOTRA
		SARLA (SITAL)
		KRUGER
		MARATHON
		C B DOCTOR
		HYDERABAD POLLUTION
		SK SYSTEM
		ADVANCE
11	INSULTATION MATERIAL	BEARDSHEL
		K-FLEX
		PARAMONT
		ARMAFLEX
		SUPREME
		LLOYDS
		UP TWIGA
		AEROCELL
12	BALANCING VALVE	ADVANCE



## AIR CONDITIONING SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

13	BUTTERFLY VALVES	ADVANCE
		AUDCO
		FOURESS ENGG
		INTER VALVE
		BDK
		WEIR BDK
		TYCO
		CRANE PROCESS
		KEystone
		FLUIDLINE
		INSTRUMENTATION LTD
		R AND D MULTIPLES (METAL CAST) PVT LTD
		SURYA VALVES AND INSTRUMENTS MFG CO
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED
UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED		
VENUS PUMPS AND ENGG. WORKS		
14	NON-RETURN VALVE	LEADER VALVES
		H SARKAR
		FLUIDLINE
		HI-TECH
		CRESCENT VALVES
		A V VALVES
		BANKIM
		SHIVADURGA
		SURYA VALVES AND INSTRUMENT MANUFACTURING
		ATAM VALVES
		GM DAULI & SONS
		KBL
		VENUS PUMPS AND ENGINEERING WORKS
15	4 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY
		JOHNSON
		BELIMO
		HONEYWELL AUTOMATION
		RAPID CONTROL
		ALC
16	BUTTERFLY VALVE (MOTORIZED)	ANERGY
		ADVANCE
		BELIMO
		JOHNSON
		HONEYWELL AUTOMATION



## AIR CONDITIONING SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

		SIEMENS
		LEADER
		H. SARKAR
		FLUID LINE
		A V VALVES
		BANKIM & COMPANY
		SURYA VALVES AND INSTRUMENT MANUFACTURING
		ATAM VALVES
		GM DAULI & SONS
		KBL
		VENUS PUMPS AND ENGINEERING WORKS
17	ACTUATOR FOR MOTORIZED BUTTERFLY VALVE	SIEMENS BUILDING TECHNOLOGY
		JOHNSON
		BELIMO
		HONEYWELL
		RAPID CONTROL
		ALC
		AUMA
		LIMITORQUE
18	Y / POT STRAINER	MULTITEX
		GREAVES COTTON
		JAYPEE
		SANT VALVES
		OTOKLIN
		GRAND PRIX
		GUJARAT OTOLIFT
		DS ENGG
		SAROJINI ENTERPRISE
		BHATIA ENGINEERING
		FILTRATION ENGINEERS INDIA PVT LTD
		SUNGOV ENGINEERING
19	Pipes (MS/GI) - ERW	SURYA ROSHNI
20	Pipes (MS/GI) - ERW	TISCO
		DADU PIPES
		INDUS TUBES
		WELSPUN
		TATA
		BST
		JINDAL
		SAIL
		PSL
		LALIT PROFILE



## AIR CONDITIONING SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

		SAMSHI PIPE INDUSTRIES
		S MUKUT PIPES
		MANN INDUSTRIES
		SURENDRA ENGINEERING
		PRATIBHA PIPES AND STRUCTURES PVT LTD
		JCO GAS PIPES
		NUKAT TANK AND VESSELS
		GOODLUCK TUBES
		ADVANCE STEEL TUBES
		BIHAR TUBES
		HITECH PIPES
		RATNAMANI
		MAHARASHTRA SEAMLESS
21	PIPING - CS SEAMLESS (ASTM A 106)	ISMT
		MAHARASHTRA SEAMLESS
22	GI SHEETS FOR DUCTING	TISCO
		INDIAN IRON & STEEL CO
		RASHTRIYA ISPAT NIGAM LIMITED
		ESSAR
		ISPAT INDUSTRIES
		JSW
		LLOYDS
		BHUSHAN STEELS
		TATA
		SAIL
		JINDAL
23	FIRE DAMPER	TSC
		CARRYAIRE
		RAVISTAR (SYSTEM AIR )
24	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW
		TSC
		AIR MASTER
		CARRYAIRE
		RAVISTAR (SYSTEM AIR)
25	STRIP HEATER	ESCORTS
		RACOLDS
		DASPASS
		ALCO
		HEATCO
		HOTSET
26	PAN HUMIDIFIER	RAPID COOL
		HOTSET



## AIR CONDITIONING SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

		ALCO
27	RELIEF / PURGE VALVE	BRASSOMATIC
28	THERMOSTATS	HONEYWELL AUTOMATION
		RANCO
		PENN
		DANFOSS
		INDFOSS
		JHONSON CONTROL
		RANUTROL
29	HUMID STAT	JHONSON CONTROL
		HONEYWELL AUTOMATION
		PENN
30	ANTI FREEZE THERMOSTAT	RANCO
		HONEYWELL AUTOMATION
		PENN
		DANFOSS
		INDFOSS
31	FLOW SWITCH	SWITZER INSTRUMENT LTD.
		LEVCON
		DK INSTRUMENTS
		SBEM
		V AUTOMAT
		SIEMENS
32	SIGHT FLOW INDICATORS	SIGMA
		LEVCON
		V AUTOMAT
		TELLACE
		EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.
		TATA HONEYWELL
		BLISS ANAND
		SCIENTIFIC DEVICES
		BK EQUIPMENTS
		INSTRUMENTATION ENGINEERS
33	RH SENSOR/TEMP SENSOR	HONEYWELL AUTOMATION
		JOHNSON
		SIEMENS
		GENERAL INSTRUMENT CONSORTIUM
34	ANNUNCIATOR	ICC
		PECON
		PROCON
35	LT ADAPTER BOX FOR AL TO CU	CONTROL DEVICE



## AIR CONDITIONING SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

	CABLE CONVERTOR	SYSTEM POWER CONTROL
		JACKSON ENGINEERS
		UNILEC
		ELECTRIC ALLIED PRODUCT
36	WATER SOFTENING PLANT	THERMAX
		ION EXCHANGE
		DOSI ION
37	ROTAMETER	CHEMTROLS SAMIL (INDIA) PVT LTD.
		EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.
		IL
		TRANSDUCERS AND CONTROL

#### NOTES:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.
3. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3, C-4 & C-5 FOR ELECTRICAL, C&I AND HANDLING RELATED EQUIPMENT LIST OF MAKE.



## VENTILATION SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

SL No	ITEM	VENDOR
1	AIR WASHER & UAF*	HYDERABAD POLUTION CONTROL
		SK SYSTEM
		ADVANCE VENTILATION
		DRAFT AIR
		BLUE STAR
		VOLTAS
		STERLING WILSON
		ROOTS COOLING SYSTEM
		C DOCTOR
		TAP
		PACK PLAST
		INDUSTRIAL PROJECTS AND PRODUCTS
2	CENTRIFUGAL FAN	FLAKT
		KRUGER
		DRAFT AIR
		HYDERABAD POLUTION CONTROL
		ADVANCE VENTILATION
		PATEL AIR
		NICOTRA
		SK SYSTEM
		MARATHON
		CB DOCTOR
		SARLA
		COMEFRI
3	FRESH AIR/ SUPPLY/ EXHAUST/ RE UNIT FANS / PROPELLAR	HYDERABAD POLUTION CONTROL
		SK SYSTEM
		ADVANCE VENTILATION
		KRUGER
		NICOTRA
		MARATHON
		FLAKT
		CB DOCTOR
		SARLA (SITAL)
		PATEL AIR
		KHAITAN
4	PUMPS	BEST & CROMPTON
		JYOTI
		SAM TURBO
		KBL
		KSB



## VENTILATION SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

		M&P
		VOLTAS
		BEACON-WEIR
		WORTHINGTON
		FLOWMORE
		SULZER PUMPS INDIA LTD.
		BHARAT PUMPS & COMPRESSORS LTD
		FLOWSERVE INDIA CONTROL PVT LTD
		V-FLOW PUMPS & SYSTEMS CO
		KISHORE PUMPS
5	LV MOTORS (FLAME PROOF)	SIEMENS
		ABB
		CGL
		MARATHON
		KEC
		BHARAT BIJLEE
		BHARAT ELECTRIC
		NGEF
		JYOTI
		LHP
6	LV MOTORS (NON-FLAME PROOF)	SIEMENS
		ABB
		CGL
		MARATHON
		KEC
		BHARAT BIJLEE
		BHARAT ELECTRIC
		NGEF
		JYOTI
		LHP
7	AIR FILTER	PUROLATOR
		FMI
		ANFILCO
		TENACITY
		JOHN FOWLER
		SPECTRUM
		AIR TECH
		PUROMATIC
8	INSULATION MATERIAL	BEARDSHEL
		K-FLEX
		PARAMONT
		ARMAFLEX



## VENTILATION SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

		SUPREME
		LLOYDS
		UP TWIGA
		AEROCELL
9	FIRE DAMPER	TSC
		CARRYAIRE
		RAVISTAR (SYSTEM AIR)
10	BUTTERFLY VALVES	AUDCO
		FOURESS ENGG
		INTER VALVE
		BDK
		WEIR BDK
		TYCO
		CRANE PROCESS
		KEYSTONE
		FLUIDLINE
		INSTRUMENTATION LTD
		R AND D MULTIPLES (METAL CAST) PVT LTD
		SURYA VALVES AND INSTRUMENTS MFG CO
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED
		VENUS PUMPS AND ENGG. WORKS
11	NON-RETURN VALVE	LEADER VALVES
		H SARKAR
		FLUIDLINE
		HI-TECH
		CRESCENT VALVES
		A V VALVES
		BANKIM
		SHIVADURGA
		SURYA VALVES AND INSTRUMENT MANUFACTURING
		ATAM VALVES
		GM DAULI & SONS
		KBL
		VENUS PUMPS AND ENGINEERING WORKS
12	STEEL GATE/GLOBE/NR VALVES (WATER SYSTEM)	CRESCENT VALVES
		BDK
		AUDCO
		FOURESS ENGG



## VENTILATION SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

		KIRLOSKAR BROTHERS LTD.
		SANT VALVES
		BOMBAY METAL & ALLOYS
		BANKIM
		LEADER VALVES
		H SARKAR
		AV VALVES
		VENUS PUMPS
		FLUIDLINE
		HI -TECH
		SHIVADURGA
		SURYA VALVES AND INSTRUMENT MANUFACTURING
		ATAM VALVES
		GM DAULI & SONS
		KBL
13	Pipes (MS/GI) - ERW	SURYA ROSHNI
		TISCO
		DADU PIPES
		INDUS TUBES
		WELSPUN
		TATA
		BST
		JINDAL
		SAIL
		PSL
		LALIT PROFILE
		SAMSHI PIPE INDUSTRIES
		S MUKUT PIPES
		MANN INDUSTRIES
		SURENDRA ENGINEERING
		PRATIBHA PIPES AND STRUCTURES PVT LTD
		JCO GAS PIPES
		NUKAT TANK AND VESSELS
		GOODLUCK TUBES
		ADVANCE STEEL TUBES
		BIHAR TUBES
		HITECH PIPES
		RATNAMANI
		MAHARASHTRA SEAMLESS
14	GI SHEETS FOR DUCTING	TISCO
		INDIAN IRON & STEEL CO



## VENTILATION SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

		RASHTRIYA ISPAT NIGAM LIMITED
		ESSAR
		ISPAT INDUSTRIES
		JSW
		LLOYDS
		BHUSHAN STEELS
		TATA
		SAIL
		JINDAL
15	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW
		TSC
		AIR MASTER
		CARRYAIRE
		RAVISTAR (SYSTEM AIR)
16	HUMID STAT	JHONSON CONTROL
		HONEYWELL AUTOMATION
		PENN
17	Y / POT STRAINER	MULTITEX
		GREAVES COTTON
		JAYPEE
		SANT VALVES
		OTOKLIN
		GRAND PRIX
		GUJARAT OTOLIFT
		DS ENGG
		SAROJINI ENTERPRISE
		BHATIA ENGINEERING
		FILTRATION ENGINEERS INDIA PVT LTD
		SUNGOV ENGINEERING
18	LOCAL CONTROL PANEL	INDUSTRIAL CONTROL & APPLIANCE
		PYROTECH ELECTRONICS PVT. LTD.
		POSITRONICS PVT. LTD.
		CONTROL & SWITCHGEAR
		SIEMENS
		L&T
		GE POWER
		RITTAL
		HOFFMAN



## VENTILATION SYSTEM

### LIST OF MAKES OF SUB-VENDOR ITEMS

**NOTES:**

1. \*Designed by Hyderabad Pollution Control / SK SYSTEM/ ADVANCE VENTILATION / DRAFT AIR/BLUE STAR/ VOLTAS/ STERLING WILSON/ROOTS COOLING SYSTEM/ C DOCTOR/ TAP/ Pack Plast/ Industrial projects and products & fabricated by their approved fabricator.
2. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.
4. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3, C-4 FOR ELECTRICAL AND C&I RELATED EQUIPMENT LIST OF MAKE.



**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC  
MANDATORY SPARE LIST**

**SPECIFICATION NO. PE-TS-466-(571-13000-  
A)-A002**

**SECTION : I**

**SUB-SECTION : E**

**REV 00**

**SECTION-I  
SUB SECTION -E**

**ANNEXURE-II**

**MANDATORY SPARE LIST  
REFER SUGGESTIVE PRICE FORMAT**



**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)**

**HVAC  
LIST OF TOOLS & TACKLES**

**SPECIFICATION No: PE-TS-466-(571-13000-  
A)-A002**

**VOLUME : II B**

**SECTION : E**

**REV 00**

## **ANNEXURE-III**

**LIST OF TOOLS & TACKLES  
REFER SUGGESTIVE PRICE FORMAT**



**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION: II**

**REV. 00**

## **SECTION II**



**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM  
LIST OF DOCUMENTS TO BE SUBMITTED WITH  
BID**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : II**

**SUB-SECTION : 2**

**REV: 00**

**SHEET 1 OF 1**

**BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:**

1. Compliance cum confirmation certificate
2. Guaranteed power consumption (In the format attached in the spec mentioning KW rating).
3. Un priced format
4. Deviation schedule /No deviation certificate in attached format 'Deviation sheet (Cost of withdrawal)'.



**3x200MW + 4X500MW KORBA TPP  
(FGD System Package)  
HVAC SYSTEM  
COMPLIANCE CUM CONFIRMATION  
CERTIFICATE**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : II**

**SUB-SECTION : 3**

**REV. NO. 00**

**SHEET: 1 OF 2**

**COMPLIANCE CUM CONFIRMATION CERTIFICATE**

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site



**3x200MW + 4X500MW KORBA TPP  
(FGD System Package)  
HVAC SYSTEM  
COMPLIANCE CUM CONFIRMATION  
CERTIFICATE**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : II**

**SUB-SECTION : 3**

**REV. NO. 00**

**SHEET: 2 OF 2**

commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.
- m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.



**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM  
PRE-BID CLARIFICATION SCHEDULE**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : II**

**SUB-SECTION : 4**

**REV. NO. 00**

**SHEET: 1 OF 1**

**PRE-BID CLARIFICATION SCHEDULE**

<b>S. NO.</b>	<b>SECTION/CLAUSE/PAGE NO.</b>	<b>STATEMENT OF THE REFERRED CLAUSE</b>	<b>CLARIFICATION REQUIRED</b>

The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: \_\_\_\_\_

Name: \_\_\_\_\_

Designation: \_\_\_\_\_

Company: \_\_\_\_\_

Date: \_\_\_\_\_

Company Seal



**3x200MW + 4X500MW KORBA TPP (FGD  
SYSTEM PACKAGE)  
HVAC SYSTEM  
NO DEVIATION CERTIFICATE**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : II**

**SUB-SECTION : 5**

**REV: 00**

**SHEET 1 OF 1**

**NO DEVIATION CERTIFICATE**

SL NO	VOULME / SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATIO N/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF DEVIATION	PORTION OF PRICE SCHEDULE ON WHICH COST OF DEVIATION IS APPLICABLE	NATURE OF COST OF DEVIATION (POSITIVE/ NEGATIVE)	WHETHER COST OF DEVIATION INCLUDED/ EXCLUDED IN PRICE BID	REMARKS
<b>TECHNICAL DEVIATIONS</b>										
<b>COMMERCIAL DEVIATIONS</b>										
<b>PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE</b>										
<b>NAME</b>				<b>DESIGNATIONS</b>			<b>SIGN &amp; DATE</b>		<b>COMPANY SEAL</b>	
<b>NOTES:</b>										
1. Cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.										
2. All the bidders have to list out all of their Technical & Commercial Deviations (if any) in detail in the above format.										
3. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.										
4. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable. In absence of same, such deviation (s) shall not be considered and offer shall be considered in total compliance to NIT.										
5. Bidder shall furnish price copy of above format along with price bid.										
6. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.										
7. Bidders to note that any deviation (technical / commercial) not listed in above and asked after Part I opening shall not be considered.										
8. For deviations w.r.t. Credit period, Liquidated damages, Firm prices if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VII, will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.										
9. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be considered.										
10. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.										
11. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.										
12. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.										
13. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.										



**3x200MW + 4X500MW KORBA TPP  
(FGD System Package)  
HVAC SYSTEM  
GAURANTEE POWER CONSUMPTION**

SPECIFICATION No: PE-TS-466-(571-13000-A)-A002

SECTION : II

SUB-SECTION : 6

REV. NO. 00

SHEET: 1 OF 1

**Guaranteed Power Consumption**

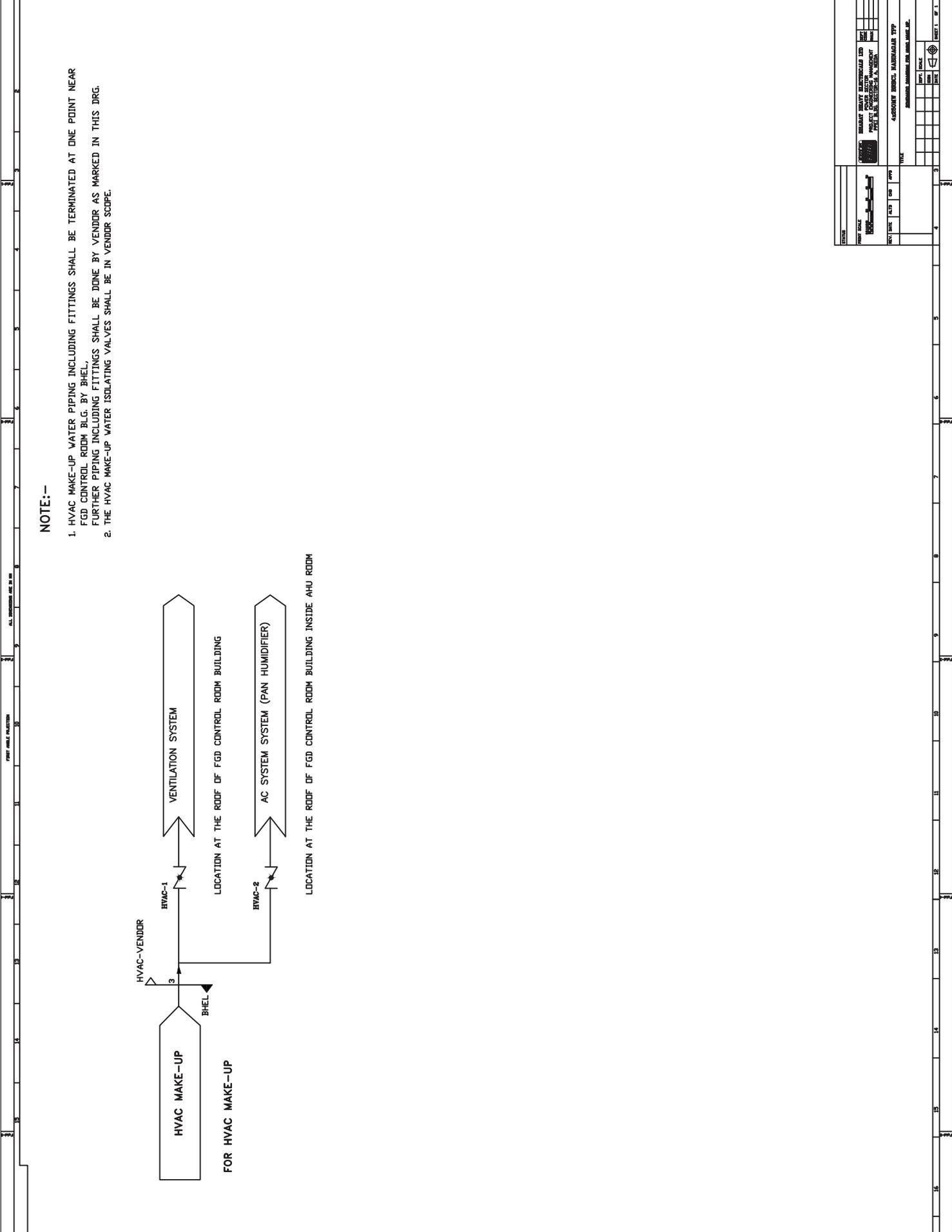
<b>NAME OF PROJECT:</b>	<b>3x200MW + 4X500MW KORBA TPP (FGD SYSTEM PACKAGE)</b>
<b>NAME OF PACKAGE:</b>	<b>HVAC FOR FGD SYSTEM</b>
<b>TECHNICAL SPECIFICATION No:</b>	<b>PE-TS-466-(571-13000-A)-A002</b>

S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY			
		3A	3B	4	5	6=3Ax4x5
<b>1</b>	<b>AC SYSTEM</b>					
<b>1.1</b>	<b>AIR COLLED CONDENSING UNIT</b>					
<b>1.1.1</b>	<b>OUTDOOR UNIT</b>	3	3		1	
<b>1.1.2</b>	<b>AHU FAN</b>	3	3	11.5	1	34.5
<b>2</b>	<b>VENTILATION SYSTEM</b>					
<b>2.1</b>	<b>UAF</b>					
<b>2.1.1</b>	<b>UAF FAN</b>	2	0		1	
<b>TOTAL (KW)</b>						

**Note:** Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as **292 KW**. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ **INR 191661/- (INR One Hundred Ninety-One Thousand Six Hundred Sixty-One only)** per KW of additional power over EPC. Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ **INR 191661/- (INR One Hundred Ninety-One Thousand Six Hundred Sixty-One only)** per KW shall be levied on vendor. Bidder to note that the GPC figure of **232 KW** includes AHU Fans GPC as well which is already supplied. The same shall be demonstrated at site during PG Test by the bidder. However, no penalty shall be levied on the bidder in case the Power Consumption of AHU Fans are measured above **34.5 KW**. Above guaranteed power consumption value shall be at 20 deg. C for centrifugal fans for AHUs and 30 deg. C for centrifugal fans of UAF units and at an elevation of RL of site for both AHUs and UAF centrifugal fans.

**Particulars of bidder / authorised representative**

<b>Name</b>	<b>Designation</b>	<b>Signature</b>	<b>DATE</b>	<b>Company Seal</b>



**NOTE:--**

1. HVAC MAKE-UP WATER PIPING INCLUDING FITTINGS SHALL BE TERMINATED AT ONE POINT NEAR FGD CONTROL ROOM BLDG. BY BHEL. FURTHER PIPING INCLUDING FITTINGS SHALL BE DONE BY VENDOR AS MARKED IN THIS DRG.
2. THE HVAC MAKE-UP WATER ISOLATING VALVES SHALL BE IN VENDOR SCOPE.

PROJECT NAME: <b>BEHALT BHEL MANIPALAM 100 MW</b> PROJECT LOCATION: <b>BEHALT</b> PROJECT NO.: <b>BE/100/001/001</b>	
SHEET NO.: <b>100-100-001-001</b> OF <b>100-100-001-001</b>	TITLE: <b>FGD CONTROL ROOM BUILDING WATER PIPING</b>
DRAWN BY: <b>...</b> CHECKED BY: <b>...</b> APPROVED BY: <b>...</b>	PROJECT MANAGER: <b>...</b> DESIGNER: <b>...</b> ENGINEER: <b>...</b>

ALL DIMENSIONS ARE IN MM  
 PRINT SCALE: **AS SHOWN**  
 ALL DIMENSIONS ARE IN MM  
 PRINT SCALE: **AS SHOWN**



**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : II**

**REV 00**

**MASTER DRAWING LIST WITH APPROVAL STATUS AND SCHEDULE OF SUBMISSION**

**3X200+3X500+1x500 MW NTPC KORBA TPP-FGD**

**HVAC SYSTEM FOR FGD (SUPPLY+SERVICE)  
MASTER DRAWING LIST**

<b>SL NO</b>	<b>DESCRIPTION</b>	<b>APPROVAL STATUS</b>
1	HEAT LOAD CALCULATION FOR A/C SYSTEM OF FGD CONTROL BUILDING	APPROVED
2	P & I DIAGRAM FOR AIR COOLED CONDENSING UNIT (DX- TYPE) FOR FGD CONTROL BUILDING	APPROVED
3	HEAT LOAD CALCULATION FOR EVAPORATIVE COOLING SYSTEM OF FGD BUILDING	APPROVED
4	P&ID FOR UAF UNIT FOR FGD BUILDING	APPROVED
5	SCHEME OF AIR DISTRIBUTION IN FGD BUILDING	APPROVED
6	TECHNICAL DATA SHEET FOR STRAINER OF VENTILATION SYSTEM	APPROVED
7	TECHNICAL DATA SHEET & G.A. DRAWING OF FIRE DAMPER WITH ACTUATOR FOR A/C & VENTILATION SYSTEM	APPROVED
8	TECHNICAL DATA SHEET & G.A. DRAWING OF AXIAL AIR FANS FOR A/C & VENTILATION SYSTEM ALONGWITH FIXING DETAILS AND GA OF PROPELLER FAN	APPROVED
9	GA OF SUPPLY/RETURN AIR DIFFUSER/GRILL FOR A/C & VENTILATION SYSTEM	APPROVED
10	TECHNICAL DATA SHEET FOR SPLIT AIR CONDITIONERS	APPROVED
11	TECHNICAL DATA SHEET FOR THERMAL & ACCOUSTIC INSULATION FOR A/C & VENTILATION SYSTEM	APPROVED
12	TECHNICAL DATA SHEET OF GI SHEET FOR AC AND VENTILATION SYSTEM	APPROVED
13	TECHNICAL DATA SHEET AND GA OF FILTERS FOR AC AND VENTILATION SYSTEM	APPROVED
14	TECHNICAL DATA SHEET OF PIPE FOR VENTILATION SYSTEM	APPROVED
15	STANDARD DRAWING FOR DUCT FABRICATION & SUPPORTING ARRANGEMENT AND ERECTION & APPLICATION DETAIL OF INSULATION	APPROVED



**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : II**

**REV 00**

16	WRITE-UP & CONTROL PHILOSOPHY FOR A/C AND VENTILATION SYSTEM	APPROVED
17	TECHNICAL DATA SHEET & G.A. DRAWING FOR HEATER PACKAGE AND PAN HUMIDIFIER	APPROVED
18	TECHNICAL DATA SHEET & GA DRAWING FOR CENTRIFUGAL PUMP FOR UAF UNIT	APPROVED
19	PG TEST PROCEDURE FOR A/C & VENTILATION SYSTEM	APPROVED
20	TECHNICAL DATA SHEET & GA OF AIR HANDLING UNITS	APPROVED
21	TECHNICAL DATA SHEET & G.A. DRWG. FOR CAST IRON VALVES(GATE VALVE,CHECK VALVE, GLOBE VALVE) OF VENTILATION SYSTEM	APPROVED
22	EQUIPMENT LAYOUT OF UAF UNIT ALONGWITH FOUNDATION DETAIL AND VENTILATION DUCT LAYOUT FOR FGD BUILDING.	APPROVED
23	VENT. ARRANGEMENT FOR VARIOUS AUXILIARY BUILDING	APPROVED
24	SPLIT AC SCHEDULE ALONGWITH HEAT LOAD CALCULATION FOR AUXILIARY BUILDING OF AC SYSTEM	APPROVED
25	VENTILATION FAN SCHEDULE	APPROVED
26	CONTROL SCHEME/ LOGIC DIAGRAM (TO BE IMPLEMENTED) FOR AC AND VENTILATION SYSTEM	APPROVED
27	TECHNICAL DATA SHEET OF CENTRIFUGAL FANS FOR AIR HANDLING UNITS AND UAF UNITS	APPROVED
28	TECHNICAL DATA SHEET & GA DRAWING OF UAF UNIT	APPROVED
29	TECHNICAL DATA SHEET & G.A DRAWING OF AIR-COOLED CONDENSING UNIT FOR FGD CONTROL BUILDING	APPROVED
30	TECHNICAL DATA SHEET FOR INSTRUMENTS (PRESSURE GAUGE, TEMPERATURE GAUGE, LEVEL GAUGE ETC) FOR AC AND VENTILATION SYSTEM	TO BE SUBMITTED WITHIN 4 WEEKS OF LOA
31	TECHNICAL DATA SHEET AND GA OF MOTOR (PUMP, AHU, UAF, AXIAL FAN)	APPROVED
32	A/C EQUIPMENT LAYOUT (AHU & OUTDOOR UNITS) WITH COMPLETE FOUNDATION DETAIL AND A/C DUCT LAYOUT FOR FGD CONTROL BUILDING	APPROVED
33	OPERATION & MAINTENANCE MANUAL FOR A/C & VENTILATION SYSTEM	APPROVED

**Notes:**

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.



**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : II**

**REV 00**

2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-
  - a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.
  - b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
  - c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / item indicating at least 3 trade names.
  - d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
  - e) Drawings/ documents to be submitted for purchaser's review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 etc.
  - f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.
  - g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.
  - h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.
  - i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
  - j) Bidder to follow the following the drawing submission schedule:
  - k) 1st submission of drawings from date of LOI as per the submission schedule.
  - l) Every revised submission incorporating comments – within 7 days.



**3x200MW + 4X500MW KORBA TPP  
(FGD SYSTEM PACKAGE)  
HVAC SYSTEM**

**SPECIFICATION No: PE-TS-466-(571-13000-A)-A002**

**SECTION : II**

**REV 00**

- m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

# APPENDIX 1

The bidder shall ensure full compliance with the Feeder List in toto without any deviations.

S No		ELECTRICAL FEEDER LIST		CUSTOMER: NTPC Limited JOB: KORBA FGD SYSTEM: HVAC										PROJECT NO. 466 Rev 00, DT: 17/01/2023, Rev 01, DT: 17/07/2023	
		TITLE		LOCATION	UNIT No	NAME PLATE KW	NO OF WORKING	NO OF STANDBY	CONTI/INT	VOLTAGE CODE	LOAD CODE	REV. NO.	REMARKS		
					T										
A.			FGD CONTROL ROOM, (ARCHITECTURAL PLANS), 21000-109-PVCB-032A												
1			UAF FAN			37	2	0	C	D	U	0	High Inertia Fans (starting time greater than 5 Second).		
2			MARINE LAMP FOR UAF			0.1	2	0	C	E	S	0			
3			UAF PUMPS			15	2	0	C	D	U	0			
4			CONTROL-PANEL-FOR-UAF			2	4	0	C	E	S	1	NOT REQUIRED		
5			FIRE DAMPER FOR VENTILATION SYSTEM			0.1	10	0	C	E	S	0	Through DCS Control Panel, Electrical to communicate requirement to C&I		
6			WALL MOUNTED AXIAL EXHAUST FAN FOR 220 V BATTERY ROOM AT EL. 19.2 M, GRID 1-2-A-B			1.1	2	0	C	D	U	0			
7			WALL MOUNTED AXIAL EXHAUST FAN FOR 24 V BATTERY ROOM AT EL. 19.2 M, GRID 3-4-A-B			1.1	2	1	C	D	U	0			
8			TOILET, GRID 10-10A-B-A FOR 4 MTR SWITCHGEAR ROOM			0.1	2	0	C	E	S	0			
9			TOILET, GRID 10-10A-B-A FOR 13.6 MTR SWITCHGEAR ROOM			0.1	2	0	C	E	S	0			
10			TOILET, GRID 10-10A-B-A FOR 19.2 MTR ROOF			0.1	2	0	C	E	S	0			
11			AIR HANDLING UNIT (AHU) FOR DX UNIT			15	3	3	C	D	U	0	High Inertia Fans (starting time greater than 5 Second).		
12			AIR COOLED CONDENSING UNIT (DX UNIT)			79.3	3	3	C	D	S	0	3 Phase 4 Wire supply to be provided.		
13			MARINE LAMP FOR AC DUCT PLENUMM			0.1	2	0	C	E	S	0			
14			FIRE DAMPER FOR AC SYSTEM			0.1	6	0	C	E	S	0	Through DCS Control Panel, Electrical to communicate requirement to C&I		
15			HEATER FOR CONDENSING UNIT -1ST DROPPER (44800 CMH)			2.3	3	0	I	D	S	1	Contacto Controlled, 3 phase 4 wire		
16			HEATER FOR CONDENSING UNIT -2ND DROPPER (21200 CMH)			1.1	3	0	I	D	S	1	Contacto Controlled, 3 phase 4 wire		
17			PAN HUMIDIFIER FOR CONDENSING UNIT			10	1	0	I	D	S	0	Contacto Controlled, 3 phase 4 wire		
18			FRESH-AIR-FAN-FOR-ABOVE-AC-ROOM			0.55	2	0	C	D	U	1	Either of the two feeders shall be used. The same shall be informed after Fresh Air Fan document finalization.		
19			FRESH AIR FAN FOR ABOVE AC ROOM. 6000 CMH 30MMWC			1.1	2	0	C	D	U	1			
B.			GENERAL ARRANGEMENTS OF LIMESTONE DAY SILOS & WET BALL MILL BUILDING, 2100-109-PVM-B-021, 0-62-411-00014												
1			WALL MOUNTED AXIAL SUPPLY FAN FOR GRAVIMETRIC FEEDER VFD ROOM	Station		0.75	2	0	C	D	U	0			
2			SUPPLY AIR FAN FOR THE BUILDING	Station		1.5	2	0	C	D	U	0			
3			EXHAUST AIR FAN FOR THE BUILDING	Station		1.1	2	0	C	D	U	0			
4			PROPELLER FAN FOR TOILETS	Station		0.1	4	0	C	E	S	0			
C.			GYPSPUM DEWATERING BUILDING (ARCH.PLAN & FINISHING SCHEDULE), 2100-109-PVC-B-023 (CARRYING COMPRESSOR HOUSE, MCC, LIMESTONE AREA AT 0.0M OF THE BUILDING)												
1			WALL MOUNTED AXIAL SUPPLY FAN FOR COMPRESSOR HOUSE AT 0.0 M AT GRID 2-4-A-B	Station		1.5	3	0	C	D	U	0			
2			WALL MOUNTED AXIAL EXHAUST FAN FOR COMPRESSOR HOUSE AT 0.0 M AT GRID 2-4-A-B	Station		0.75	2	0	C	D	U	0			
3			WALL MOUNTED AXIAL SUPPLY FAN FOR- SWITCH GEAR AT 0.0M 2-4-B-C	Station		2.2	5	0	C	D	U	0			
4			WALL MOUNTED AXIAL SUPPLY FAN FOR LIMESTONE AREA AT 0.0 M AT GRID 9-10-A-B	Station		1.1	1	0	C	D	U	0			
5			WALL MOUNTED AXIAL EXHAUST FAN FOR LIMESTONE AREA AT 0.0 M AT GRID 9-10-A-B	Station		0.55	1	0	C	D	U	0			
6			WALL MOUNTED AXIAL SUPPLY FAN FOR- BELT FILTER AT 10.0M AT GRID 1-10-A-B-C	Station		1.5	26	2	C	D	U	0			

7	ROOF EXTRACTOR UNIT - BELT FILTER AT 19.1 M AT GRID 1-10-A-B-C	Station	5-5	4	0	C	D	U	0	
8	WALL MOUNTED AXIAL SUPPLY FAN FOR - PRIMARY HYDROCLONE AREA AT 19.4M	Station	1.5	2	1	C	D	U	0	
9	WALL MOUNTED AXIAL EXHAUST FAN FOR - PRIMARY HYDROCLONE AREA AT 19.4M	Station	1.1	1	1	C	D	U	0	
10	LADIES TOILET FOR ABOVE BUILDING	Station	0.1	2	0	C	E	S	0	
11	GENTS TOILET FOR ABOVE BUILDING	Station	0.1	2	0	C	E	S	0	
D	2100-109-PVC-B-072, 33 KV SWITCHGEAR ROOM ARCH PLAN									
1	WALL MOUNTED AXIAL SUPPLY FAN FOR - CABLE VAULT GRID 1-5-A-B		1.1	5	1	C	D	U	0	
2	WALL MOUNTED AXIAL SUPPLY FAN FOR - SWITCHGEAR GRID 1-5-A-B		1.1	5	1	C	D	U	0	
3	SPLIT AC FORAC AREA UNIT-1		3	2	2	C	E	S	0	
E	RIO ROOM, UNIT-5 ABSORBER (DRAWING RECEIVED VIDE C&I MAIL DATED 27/12/2022)									
1	BIFURCATED EXHAUST FAN FOR BATTERY ROOM FOR RIO PANELS		0.55	2	0	C	D	U	0	
2	SPLIT AC FOR RIO ROOM		3	6	6	C	E	S	0	
3	TOILET		0.1	2	0	C	E	S	0	
1	NOTES:									
	<p>1. FOLLOWING BUILDINGS / AREAS OF THE BUILDINGS ARE OPEN TYPE &amp; DOES NOT HAVE ANY WALL. ACCORDINGLY, VENTILATION SYSTEM IS NOT APPLICABLE.</p> <p>A) GA &amp; PIPING LAYOUT IN &amp; AROUND ACW / ECW PUMP SHED FOR FGD, 2100-109-PVM-F-048; PE-DG-466-181-M001 - SHED</p> <p>B) GYPSUM DEWATERING BUILDING (ARCHITECTURAL PLANS &amp; FINISHING SCHEDULE), 2100-109-PVC-B-023 (CARRYING COMPRESSOR HOUSE &amp; MCC AT 0.0M OF THE BUILDING), GROUND FLOOR (0.0M TO 10.0M) IS OPEN.</p> <p>C) RC PUMP &amp; OXIDATION BLOWER HOUSE (GA &amp; RC DETAILS OF FOUNDATIONS) - OPEN BUILDING</p> <p>D) GENERAL ARRANGEMENTS OF LIMESTONE DAY SILOS &amp; WET BALL MILL BUILDING, 2100-109-PVM-B-021, 0-62-411-00014, BUILDING IS OPEN.</p> <p>2. VENTILATION SYSTEM FOR THE LIMENSTONE HANDLING SYSTEM, REVERSIBLE BELT FILTER SHALL BE IN BHEL ISG SCOPE.</p>									
2	<p>ABBREVIATIONS : *VOLTAGE CODE (AC), A=11KV, B=6.6KV, C=3.3KV, D=415V, E=240V (1 PH), F=110 (DC) G=220V, H= 110V, K=+24V, L=-24V</p> <p>** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTOR CONTROLLED)</p>									



HEAT LOAD CALCULATION FOR 3X200 +4X500 MW  
KORBA TPP (FGD SYSTEM PACKAGE)



PROJECT : 3X200+4X500 MW NTPC KORBA TPS (FGD SYSTEM PACKAGE)																				
OWNER : NTPC LIMITED										EPC Contractor : BHEL										
SUMMARY SHEET FOR FGD BUILDING																				
Date: 27.08.2022																				
Rev.: 1																				
S.no	Area Description	Length(Ft)	Width(Ft)	Floor Area(sqft)	Height ( Ft )	Equip. Load(W)	Occup. (Persons)	Room Design Temp. in deg. F	Room Design RH in %age	Fresh air ACPH	Fresh air CFM	Dehumidified Unit CFM	Unit Ref. Load (TR)	Winter Load (KW)	Monsoon Heater (KW)	Heater (Selected) (KW)	Humidifier (KW)	Unit Ref. Load (TR) with 10% Margin	Dehumidified Unit CFM with 10% margin	Equipment selected
<b>A. FGD CONTROL ROOM BUILDING : REF DWG No.:PE-DG-466-100-E001, 0270-109-PVE-B-030</b>																				
1	FGD CONTROL ROOM,AB-6-9	73.41	36.33	2666.68	10.82	23460	10	75.2	50.0	1.5	721.60	6985	17.30	2.72	2.73	2.73	-3.34	19.02	7684	ACCU: 3W+3S-50TR (Actual)
2	FGD CONTROL ROOM,AB-9-10	29.60	36.33	1075.32	10.82	8600	10	75.2	50.0	1.5	290.98	2935	7.39	-0.01	1.46	1.46	-1.35	8.12	3229	AHU: 3W+3S- 22000 CFM
3	FGD CONTROL ROOM,BC-6-10	103.01	27.47	2829.73	10.82	237000	11	75.2	50.0	1.5	765.73	48156	89.11	106.55	3.36	3.36	-3.55	98.02	52972	HEATER: 1 LOT- 10 KW
4	AHU ROOM, FGD ROOF, AB-06-10	103.01	27.88	2871.97	16.40	2500	0	75.2	50.0	0.0	0.00	0	9.38	0.00	0.00	0.00	0.00	10.31	0	PAN HUMIDIFIER: 1W- 10.0KW
	<b>TOTAL</b>	-	-	<b>9443.70</b>	<b>48.87</b>	<b>271560.00</b>	<b>31.00</b>	<b>300.80</b>	<b>200.00</b>	<b>4.50</b>	<b>1778.31</b>	<b>58076.94</b>	<b>123.17</b>	<b>109.26</b>	<b>7.56</b>	<b>7.56</b>	<b>-8.24</b>	<b>135.48</b>	<b>63884.63</b>	<b>FA FAN: (1W+1S)- 3300 CFM EACH</b>



ANNEXURE III																				
for Evaporative Cooling - FGD Electrical & Control Room Building 4x200 MW+4x500 MW KOREA TPP																				
Sr No.	Description of Area	Length (m)	Width (m)	Area (m <sup>2</sup> )	Total Area (m <sup>2</sup> )	Height (m)	Based on Air Change				Based on Heat Desipation				Selected Air Flow (CMH) (Max of ACH & Heat load method)	Selected Air Including 10% Margin as per Specification	Air Flow Provided (CMH)	Gravity backdraft Damper (in SQM)	Remarks	Reference Drawing Title & Number
							Air change / hour	Air Flow (CMH)	Heat Dissipation (KW)	Lighting load (KW)	Solar Heat Load (KW)	Total Heat Load (KW)	Air Flow (CMH)	Total Heat Load (KW)						
1	Cable Vault at 0.0 M LVL	69.07	19.355	1337	1337	3.8	8	40640.24	20.05	20.05	2.89	43.00	14553	40640	44704	45000	1.46	Exhaust through Pressure relief Damper	FGD CONTROL ROOM BUILDING (ARCHITECTURAL PLAN) - PE-DG-466-100-E001, REV.03	
2	Switch Gear Room at 4.0 M LVL	69.07	19.355	1337	1337	5.4	8	57751.91	98.74	26.74	6.29	131.77	44602	57752	63527	95000	3.08	Exhaust through Pressure relief Damper	FGD CONTROL ROOM BUILDING (ARCHITECTURAL PLAN) - PE-DG-466-100-E001, REV.03	
3	Cable Vault at 9.6 M LVL	69.07	19.45	1343	1343	3.8	8	40839.71	20.15	20.15	5.07	45.37	15358	40840	44924	45000	1.46	Exhaust through Pressure relief Damper	FGD CONTROL ROOM BUILDING (ARCHITECTURAL PLAN) - PE-DG-466-100-E001, REV.03	
4	Switch Gear Room at 13.6 M LVL	37.409	19.49	729	729	5.4	8	31497.18	75.59	14.58	7.16	97.33	32945	32945	36240	55000	1.78	Exhaust through Pressure relief Damper	FGD CONTROL ROOM BUILDING (ARCHITECTURAL PLAN) - PE-DG-466-100-E001, REV.03	
							<b>1,70,729</b>								170729	<b>1,89,395</b>	<b>2,40,000</b>			



DATE	REVISIONS	DESCRIPTION
0	1	ISSUED FOR CONSTRUCTION
0	2	REVISED
0	3	REVISED

PROJECT TITLE	HEAT COOLING SYSTEMS FOR EXPERIMENTAL COOLING SYSTEMS OF FGD BUILDING
PROJECT NO.	2100-105-PH-4-002A
CLIENT	NTPC Limited
DESIGNER	BNM&P ENGINEERING MANAGEMENT

REV. NO.	DESCRIPTION	DATE	BY	CHKD	APPD
0	SUBMITTED FOR REVIEW / APPROVAL	14/07/2022			

**REVIEWED**  
By VIPIN NAUNI at 10:54 am, Jul 16, 2022

DRG. NO.	2100-105-PH-4-002A
CUSTOMER	NTPC Limited
PROJECT	3X200P350000T (3X200MW) SUPERCRITICAL COAL FIRED UNIT-4, KORBA TPP
PROJECT ENGINEERING MANAGEMENT	BNM&P HEAVY ELECTRICALS LTD
PROJECT ENGINEERING MANAGEMENT	BNM&P ENGINEERING MANAGEMENT

DRG. NO.	466		
CONTRACT			
DISTRIBUTION			
REV. DATE	ALTD	CHD	APPD

DATE	BY	CHKD	APPD
14/07/2022			

DATE	BY	CHKD	APPD
14/07/2022			

DATE	BY	CHKD	APPD
14/07/2022			

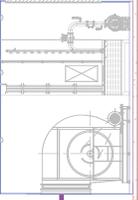
DATE	BY	CHKD	APPD
14/07/2022			

DATE	BY	CHKD	APPD
14/07/2022			

DATE	BY	CHKD	APPD
14/07/2022			

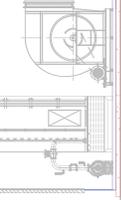
⑥

**TERRACE PLAN**



⑤

SUPPLY AIR PLENUM

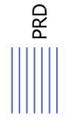


④

EL (+)19.20M (FFL)

AC CONTROL ROOM

SUPPLY AIR QTY. 55,000 CMH  
SWITCHGEAR ROOM



EL (+)13.60M (FFL)

SUPPLY AIR QTY. 45,000 CMH  
CABLE VAULT ROOM



EL (+)9.60M (FFL)

SUPPLY AIR QTY. 95,000 CMH  
SWITCHGEAR ROOM



EL (+)4.00M (FFL)

SUPPLY AIR QTY. 45,000 CMH  
CABLE VAULT ROOM



EL (+)0.00M (FFL)

**SCHEME OF AIR DISTRIBUTION IN FGD BUILDING**

<b>Customer</b>	<b>NTPC</b>	<b>Job No.</b>	<b>M22/DEL-15.BHEL</b>
<b>Project</b>	<b>3X200+3X500+1x500 MW NTPC KORBA TPP-FGDP</b>	<b>Date</b>	<b>14.12.2021</b>
<b>BHEL Doc. No.</b>	<b>PE-V0-466-(571-13000-A)-A205</b>		

<b>Sr.No.</b>	<b>Description</b>	<b>Details</b>
1	Item	POT Strainer
2	Make	Sant Industrial
3	Qty	1 nos
4	Size	150mm
5	Location	UAF (FGD Control Building at 13.500M)
6	Maximum Permissible Pressure drop at 50% Clogging	0.2kg/cm <sup>3</sup>
7	<b>Material of Construction</b>	
7.1	Body	Mild Steel (IS:2062-1992, Gr.B)
7.2	Bonnet	Cast Iron IS:260 (Gr.260)
7.3	Body/Bonnet Bolts	A-307Gr.B
7.4	Basket (Filter Screen)	SS-304 Perforated Filter Screen of 3mm perforation, 24G
7.5	Body Cover Sheet	Black Nitrile Rubber Gasket
7.6	Drain Plug	A-307Gr.B
7.7	End Connection	Flanged (As per BS-10)
8	Pressure Class	PN16
9	Body Test Pressure	16kg/cm <sup>2</sup>
10	Dimensions	As per GA
11	Painting	2 coats of synthetic enamel over 2 coats of primer total DFT minimum 80-100 microns Shade Dark Grey
12	Inspection	As per approved ICP

Prep. By

Appr. By

# POT STRAINER

Pot-11

Series : SI/PN-16/40-600

M.S. Body. Flanged End Connection.



## TESTING OF POT STRAINER AS PER

### BS - 6755 : PART-1

Hydro Testing Only

SHELL

225 PSIG

16 BAR

- STRAINER SHALL BE TESTED HYDROSTATICALLY UPTO 225 PSIG.
- PRESSURE CLASSIFICATION SHALL BE AS PER PN-16 RATING.
- 
- 

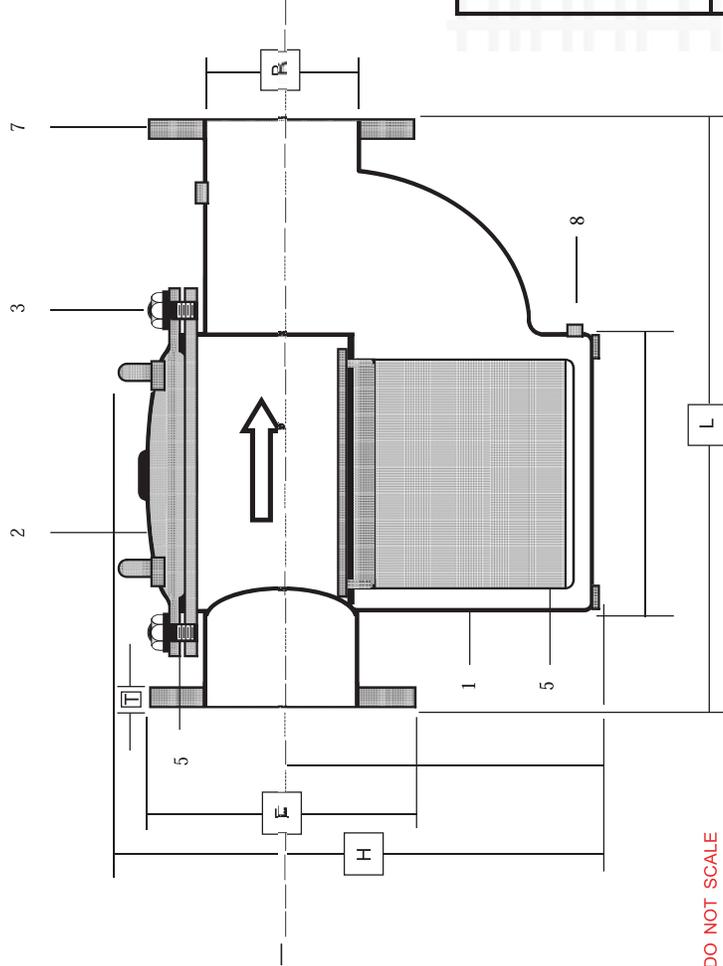
**Dimensional Tolerance ± 5-7mm**

## TECHNICAL SPECIFICATIONS

NOMINAL SIZE	DN	L	H	F	A	B	T	No of Holes (Side Flanges)
150	MM	533	546	280	---	150	13	8 No's

## MATERIAL SPECIFICATIONS

1	BODY	: MILD STEEL ( IS:2062-1992 Gr.A )
2	BONNET	: CAST IRON. ( IS:210, Gr. 260 )
3	BODY / BONNET BOLTS	: Steel A-307. Gr. B.
4	BASKET ( Screen )	: Stainless Steel - 304 Screen of 3 mm Perforation X 24 $\phi$ Thickness.
5	BODY / BONNET GASKET	: Black Nitrile Rubber Gasket.
6	SIDE FLANGES.	: Dimensions & Drilling Of Flanges As per BS - 10 Table 'D'. Specifications.
7	DRAIN PLUG	: A-307. Gr. B.
8	TEST PRESSURE.	: 225 psig
9	PRESSURE CLASS.	: PN-16 Rating
10	PERMANENT MAGNET	: ---
11	PAINT FINISH.	: 2- Coats Of Synthetic Enamel over 2- Coats Of Primer Total DFT Minimum 80-100 Microns-SHADE: Dark Grey.



DO NOT SCALE THE DRAWING



**SANT INDUSTRIAL CONTROLS PVT. LTD.**  
Engineers Manufacturers & Traders

Block 'A'-94/1 Sudershan Park, Moti Nagar, New Delhi - 110 015, India.  
Phone : 91-11-25419419, 25448444, E-mail: info@sant.co.in, Website: www.sant.co.in.



# Pot Strainer

Series : SI/PN-16/40-600

DATE : 22.04.2021

Drg. No : SI/PN-16

Pot Strainer

<b>Sr. No.</b>	<b>Description</b>	<b>Details</b>
1	Make	System Air
2	Item	Fire Damper
3	Type	Motorized And Spring Return Fall Safe Type
4	Size & Quantity	As per Approved Layout(AC&Ventilation)
5	Model	WGD
6	Louver Blade	GI, 16G/ Double Skin Type
7	Casing	GI,16G/ Formed From Four Hat Channel Shape 165mm Wide Having Flanges For Connecting Damper To Sleeve
8	Shaft	18MM X 14MM X Dia Circular Rod
9	Make Of GI Sheet	Tata/Jindal/Bhushan/Essar
10	Fabrication Type	Box Type
11	Linkage / Bush	U Type Linkage, Steel IS-9550 Flat Chrome Plated Handle For Actuator
12	Working	Normally Open, In Case Of No Power Damper Will be Closed By Spring Action
13	Fire Rating	90 Minutes (Minimum)
14	Leakage Class	Class-I
15	Side Seal	SS
16	Spring	Spring Steel Grade 2
17	Mounting	Duct/ Wall Mounted
18	Depth	165MM
19	Gland Packing	Jamb Seal
20	Reference Code/ Standard	UL-555, 1955 (Certified By CBRI)
21	<b>Single Phase Actuator</b>	
21.1	Make Of Actuator	Belimo
21.2	Model No.	NFA S2 FOR 10MM
21.3	Actuator Voltage	AC 240 V , 50 HZ , Single Phase
21.4	Power Consumption	10 Watt (Max.)
21.5	Angle Of Rotation	95 Degree (Max.)
21.6	Switch Type	SPDT 2 Set
21.7	Torque	10 NM
21.8	Contact Rating	2NO+2NC, with contact rating of 240VAC/24VDC,0.5 AMP

21.9	Degree Of Protection	IP 54
22	<b>Running Time</b>	
22.1	Motor	75 Seconds
22.2	Spring Return	20 Seconds
23	<b>Sound Level</b>	
23.1	Motor	45 Db(max.)
23.2	Spring Return	62 Db(max.)
24	Auxiliary Contacts	Limit Switches For Open & Close Position
24	Mode Of Control	Open - Actuator Energized
		Close- Actuator De-Energized & Spring Action

Prep. By

Appr. By



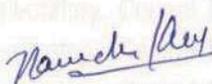
TEST SCHEDULE 1/2  
(Reference No. – FR / 0065 )

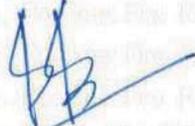
1. Name of the Laboratory : Fire Research Laboratory  
CSIR-Central Building Research Institute,  
Roorkee-247 667
2. Name of the Party : M/s Systemair india Pvt. Ltd.,  
Plot no. 3, Sector 31, Ecotech-1  
Kasna, Greater Noida-201 308
3. Name of the Test : Fire Endurance and Hose Stream
4. Date of Test : September 24, 2015
5. Ambient Temperature : 29<sup>o</sup> C
6. Test Procedure : As per UL:555, 1995
7. Specimen Details : Fire Damper (Sensor operated)
- | Size          | Frame        |
|---------------|--------------|
| Height        | : 1000 mm    |
| Width         | : 1000 mm    |
| Thickness     | : 450 mm     |
| No. of Blades | : Seven Nos. |
8. Damper Construction : As shown in Figure 1  
(Drg No. 1/2 – 0065 (1))
9. Damper Position : Up- Stream Position
10. Intended Test Duration : 120 Min.

Test Results

The test results and observations of fire endurance and hose stream evaluation of fire damper specimen reveal that the damper specimen (**Up-Stream position**) was able to comply with the clause 10 of standard UL: 555-1995. Hence the fire damper specimen (**Up-Stream position only**) may be rated for 120 minutes (One hundred twenty minutes only).

  
(Sushil Kumar)

  
(Narendra Kumar)

  
(Dr. Suvir Singh)

(Technical data provided in this schedule pertains to the specific sample submitted to the Institute and tested. CBRI's name or logo cannot be used for commercial purposes. All procedural, legal, and / or operational matters will be the responsibility of the party using these results. Accepting / Rejecting the results, partly or fully rests with the users agencies.)



**FIRE RESEARCH LABORATORY**  
**CSIR - Central Building Research Institute**  
**Roorkee - 247 667 (U.K.) INDIA**



TEST SCHEDULE 2/2  
(Reference No. – FR / 0065 )

1. Name of the Laboratory : Fire Research Laboratory  
CSIR-Central Building Research Institute,  
Roorkee-247 667
2. Name of the Party : M/s Systemair india Pvt. Ltd.,  
Plot no. 3, Sector 31, Ecotech-1  
Kasna, Greater Noida-201 308
3. Name of the Test : Fire Endurance and Hose Stream
4. Date of Test : September 29, 2015
5. Ambient Temperature : 29° C
6. Test Procedure : As per UL:555, 1995
7. Specimen Details : Fire Damper (Sensor operated)
- | Size          | Frame        |
|---------------|--------------|
| Height        | : 1000 mm    |
| Width         | : 1000 mm    |
| Thickness     | : 450 mm     |
| No. of Blades | : Seven Nos. |
8. Damper Construction : As shown in Figure 1  
(Drg No. 2/2 – 0065 (1))
9. Damper Position : Down- Stream Position
10. Intended Test Duration : 120 Min.

Test Results

The test results and observations of fire endurance and hose stream evaluation of fire damper specimen reveal that the damper specimen (**Down-Stream position**) was able to comply with the clause 10 of standard UL: 555-1995. Hence the fire damper specimen (**Down-Stream position only**) may be rated for 120 minutes (One hundred twenty minutes only).

(Sushil Kumar)

(Narendra Kumar)

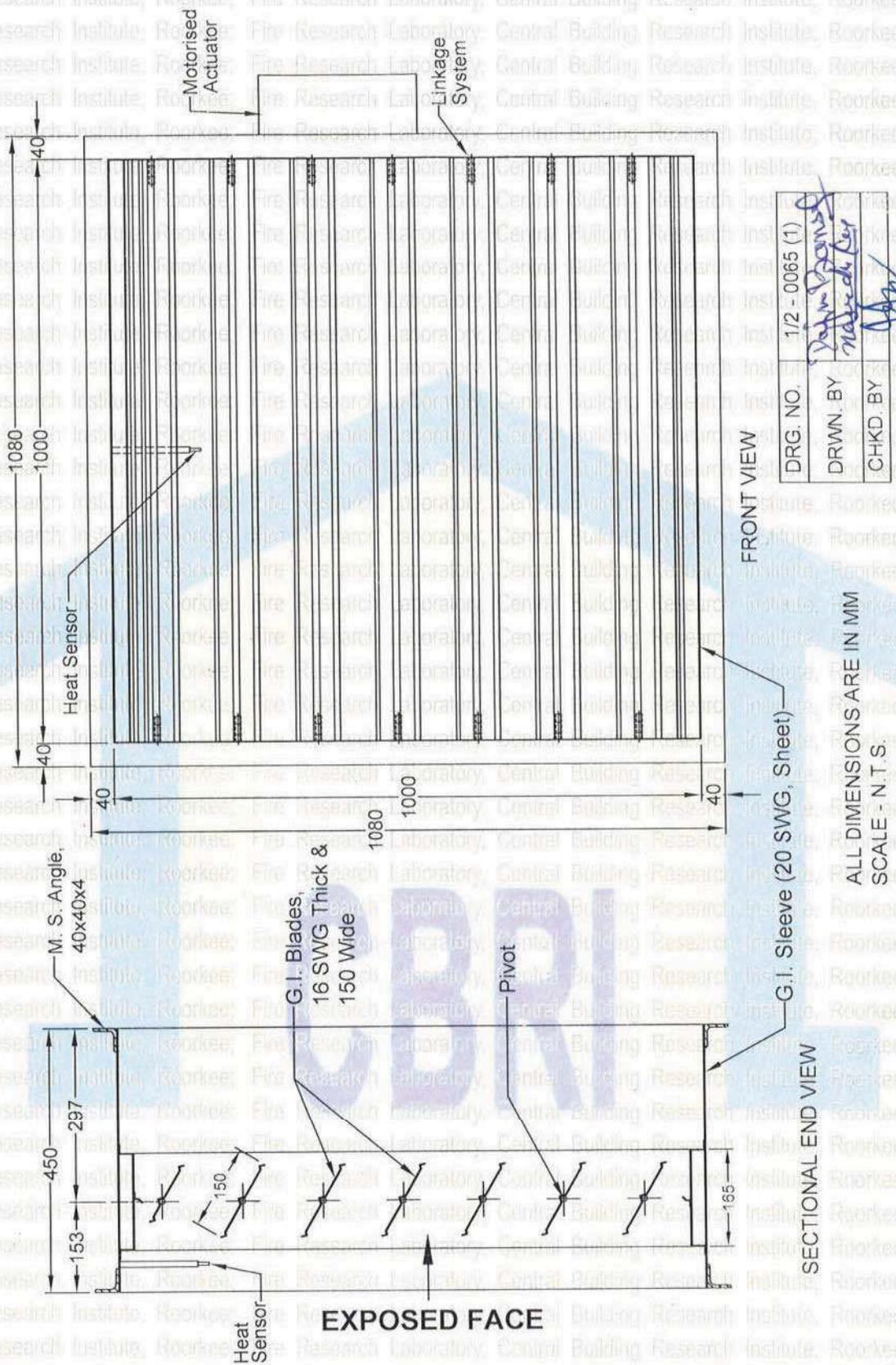
(Dr. Suvir Singh)

(Technical data provided in this schedule pertains to the specific sample submitted to the Institute and tested. CBRI's name or logo cannot be used for commercial purposes. All procedural, legal, and / or operational matters will be the responsibility of the party using these results. Accepting / Rejecting the results, partly or fully rests with the users agencies.)



**FIRE RESEARCH LABORATORY**  
CSIR - Central Building Research Institute  
Roorkee - 247 667 (U.K.) INDIA





ALL DIMENSIONS ARE IN MM  
SCALE - N.T.S.

Figure 1 : Construction details of Damper specimen evaluated for Fire & Hose Stream in Up Stream position on September 24, 2015.



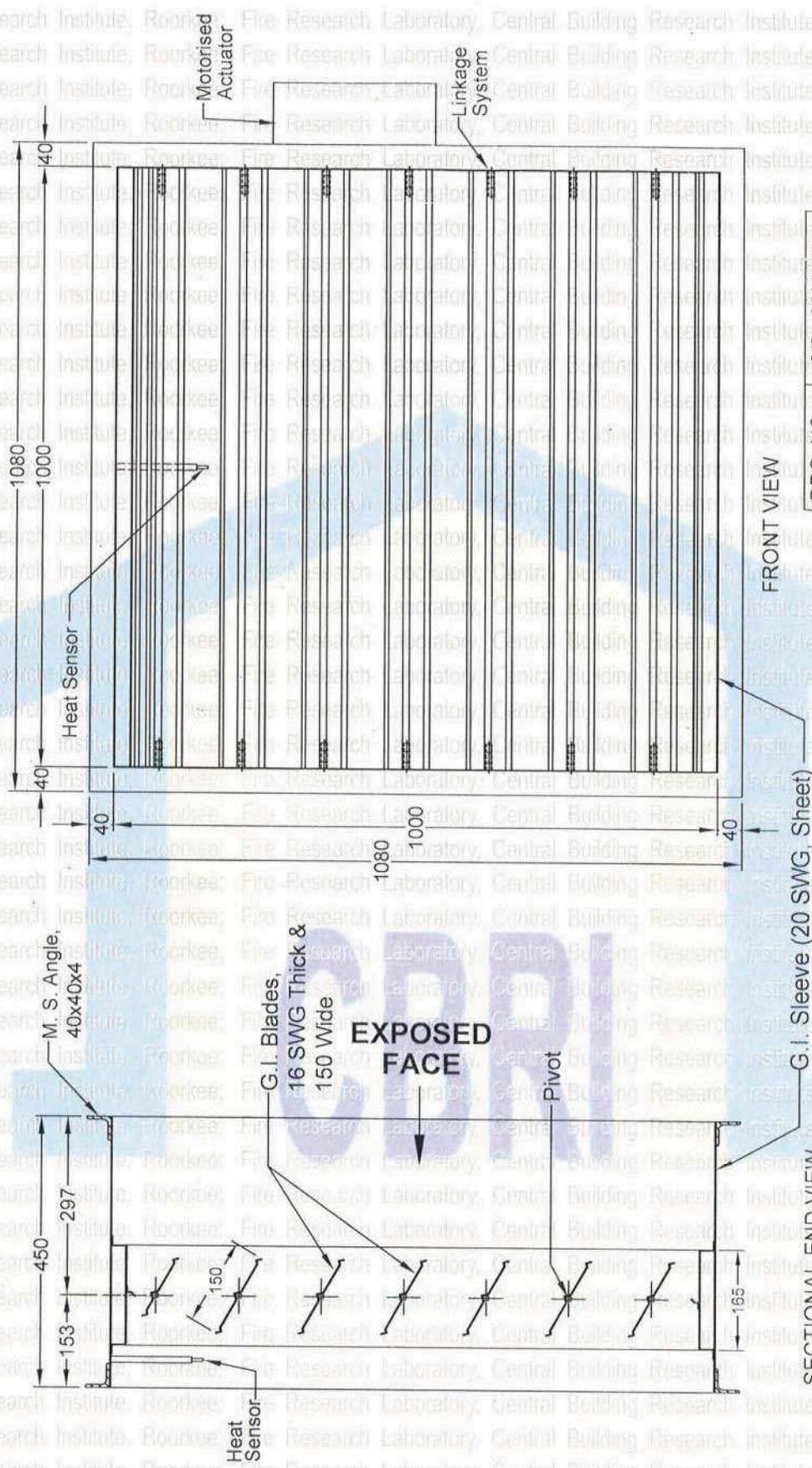
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CSIR - Central Building Research Institute

Roorkee - 247 667 (U.K.) INDIA



Note: This original only is valid. Third parties using copies are doing so at their own risk



DRG NO.	2/2 - 0065 (1)
DRWN. BY	<i>[Signature]</i>
CHKD. BY	<i>[Signature]</i>

ALL DIMENSIONS ARE IN MM  
SCALE - N.T.S.

**Figure 1 : Construction details of Damper specimen evaluated for Fire & Hose Stream in Down Stream position on September 29, 2015.**



**FIRE RESEARCH LABORATORY**  
**CSIR - Central Building Research Institute**  
**Roorkee 247 667 (U.K.) INDIA**



Note: This drawing is valid for parties using copies are doing so at their own risk

Spring return actuator with emergency function for adjusting air dampers in ventilation and air conditioning systems in buildings

- For air dampers up to approx. 2 m<sup>2</sup>
- Torque 10 Nm
- Nominal voltage  
AC 24 ... 240 V / DC 24 ... 125 V
- Control: Open-close
- Two integrated auxiliary switches


**Technical data**

<b>Electrical data</b>	Nominal voltage	AC 24 ... 240 V, 50/60 Hz / DC 24 ... 125 V	
	Nominal voltage range	AC 19,2 ... 264 V / DC 21,6 ... 137,5 V	
	Power consumption	In operation	6 W @ nominal torque
		At rest	2,5 W
		For wire sizing	9,5 VA
	Auxiliary switch	2 x SPDT, 1 mA ... 3 (0.5) A, AC 250 V <input type="checkbox"/> (1 x fix 10% / 1 x adjustable 10 ... 90%)	
Connection	Motor	Cable 1 m, 2 x 0.75 mm <sup>2</sup>	
	Auxiliary switch	Cable 1 m, 6 x 0.75 mm <sup>2</sup>	
<b>Functional data</b>	Torque	Motor	Min. 10 Nm @ nominal voltage
		Spring return	Min. 10 Nm
	Direction of rotation	Can be selected by mounting L / R	
	Manual override	With hand crank and interlocking switch	
	Angle of rotation	Max. 95°↔, can be limited with adjustable mechanical end stop	
	Running time	Motor	≤75 s (0 ... 10 Nm)
		Spring return	20 s @ -20 ... 50°C / max. 60 s @ -30°C
	Sound power level	Motor	≤45 dB (A)
		Spring return	≤62 dB (A)
	Service life	Min. 60,000 emergency positions	
	Position indication	Mechanical	
<b>Safety</b>	Protection class	II Totally insulated <input type="checkbox"/>	
	Degree of protection	IP54	
		NEMA2, UL Enclosure Type 2	
	EMC	CE according to 2004/108/EC	
	Low-voltage directive	CE according to 2006/95/EC	
	Certification	Certified to IEC/EN 60730-1 and IEC/EN 60730-2-14 cULus according to UL 60730-1A and UL 60730-2-14 and CAN/CSA E60730-1:02	
	Mode of operation	Type 1.AA.B	
	Rated impulse voltage	Actuator	4 kV
		Auxiliary switch	2,5 kV
	Control pollution degree	3	
Ambient temperature	-30 ... +50°C		
Non-operating temperature	-40 ... +80°C		
Ambient humidity	95% r.h., non-condensating		
Maintenance	Maintenance-free		
<b>Dimensions / Weight</b>	Dimensions	See «Dimensions» on page 3	
	Weight	Approx. 2.2 kg	

Safety notes



- The actuator is not allowed to be used outside the specified field of application, especially in aircraft or in any other airborne means of transport.
- **Caution: Power supply voltage possible!**
- It may only be installed by suitably trained personnel. Any legal regulations or regulations issued by authorities must be observed during assembly.
- The device may only be opened at the manufacturer's site. It does not contain any parts that can be replaced or repaired by the user.
- The cables must not be removed from the device.
- When calculating the required torque, the specifications supplied by the damper manufacturers (cross-section, design, installation site), and the air flow conditions must be observed.
- The integrated switches of this actuator have to be connected either to Power supply voltage or safety extra low voltage. The combination Power supply voltage / safety extra low voltage is not allowed.
- The device contains electrical and electronic components and is not allowed to be disposed of as household refuse. All locally valid regulations and requirements must be observed.

Product features

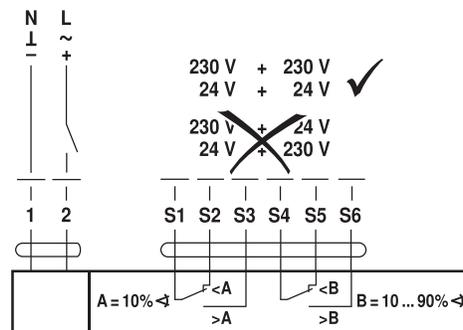
<b>Mode of operation</b>	The actuator is equipped with a universal power module and can process supply voltages from AC 24 ... 240 V plus DC 24 ... 125 V. The actuator moves the damper to the operating position at the same time as tensioning the return spring. The damper is turned back to the emergency position by spring force if the supply voltage is interrupted.
<b>Simple direct mounting</b>	Simple direct mounting on the damper spindle with a universal spindle clamp, supplied with an anti-rotation strap to prevent the actuator from rotating.
<b>Manual override</b>	Manual operation of the damper with the hand crank, locking in any position with the interlocking switch. Unlocking is manual or automatic by applying the operating voltage.
<b>Adjustable angle of rotation</b>	Adjustable angle of rotation with mechanical end stop.
<b>High operational reliability</b>	The actuator is overload-proof, requires no limit switches and automatically stops when the end stop is reached.
<b>Flexible signalization</b>	The actuator has one auxiliary switch with a fixed setting and one adjustable auxiliary switch. They permit a 10% or 10 ... 90% angle of rotation to be signalled.

Electrical installation

Wiring diagram

Notes

- Caution: Power supply voltage possible!
- Parallel connection of other actuators possible. Note the performance data.



Cable colours:

- 1 = blue
- 2 = brown
- S1 = violet
- S2 = red
- S3 = white
- S4 = orange
- S5 = pink
- S6 = grey

Accessories

	Description	Data sheet
<b>Electrical accessories</b>	Auxiliary switch unit S2A-F *	T2 - S2A-F
	Feedback potentiometer unit P200A-F *	T2 - P200A-F
<b>Mechanical accessories</b>	Various accessories	

\* further versions on request

Dimensions [mm]

Dimensional drawings

Variant 1a:

3/4"-spindle clamp (with insertion part) EU Standard

Damper spindle	Length			
	≥85	10 ... 22	10	14 ... 25.4
	≥15			

Variant 1b:

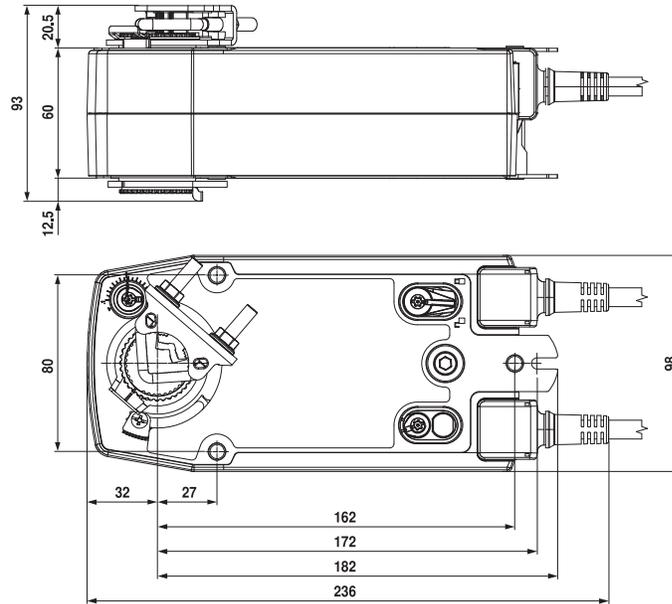
1"-spindle clamp (without insertion part) EU Standard

Damper spindle	Length		
	≥85	19 ... 25.4	12 ... 18
	≥15	(26.7)	

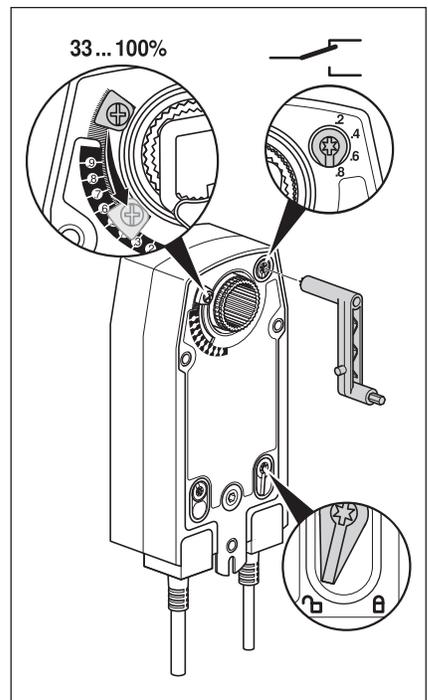
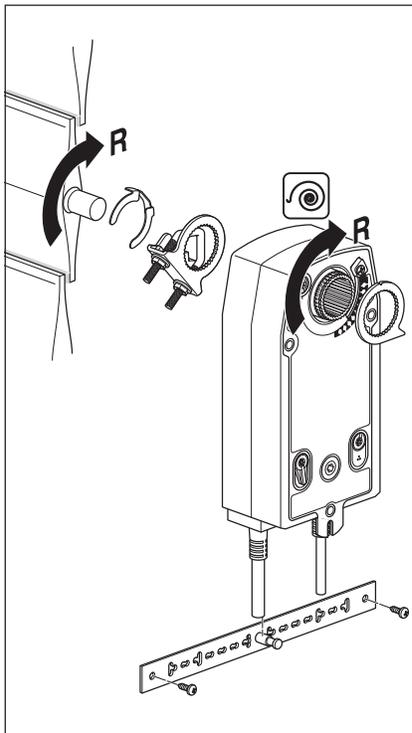
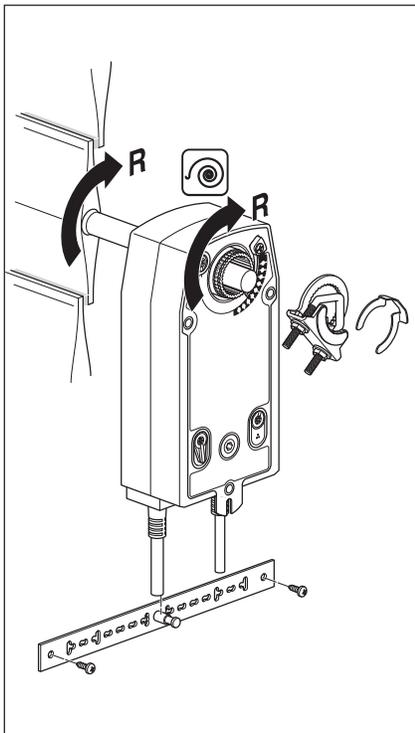
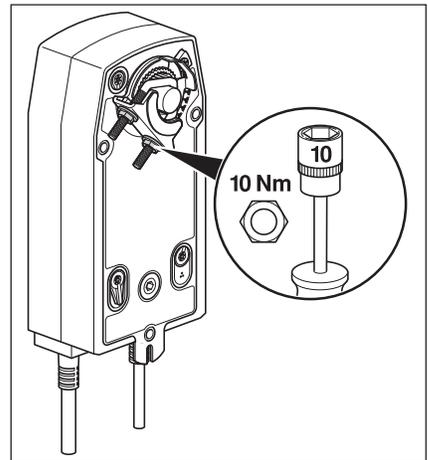
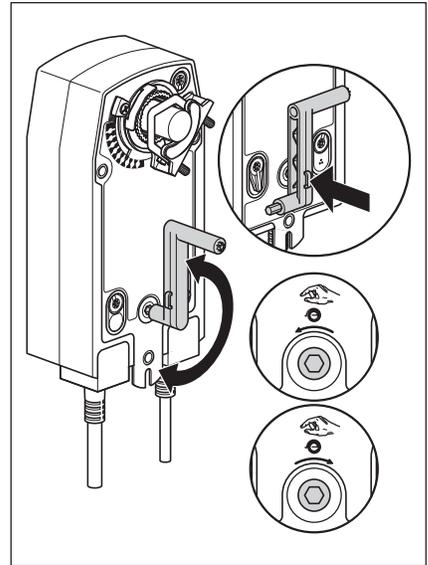
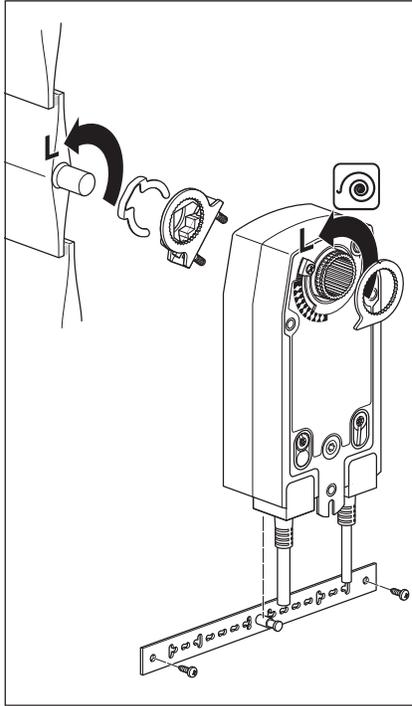
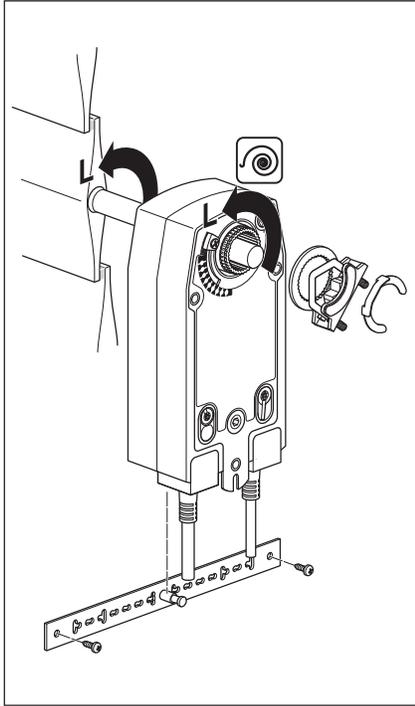
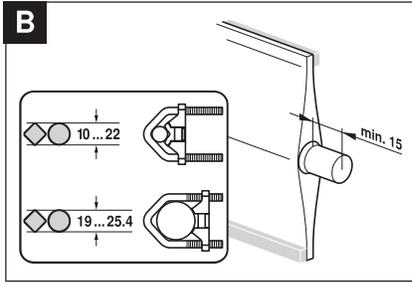
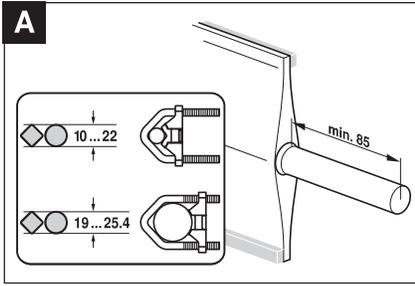
Variant 2:

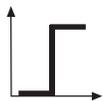
1/2"-spindle clamp (optional via configuration)

Damper spindle	Length		
	≥85	10 ... 19	14 ... 20
	≥15		

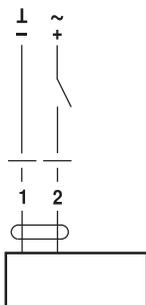


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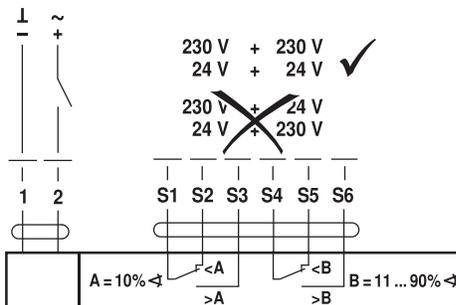




AC 24 V / DC 24 V



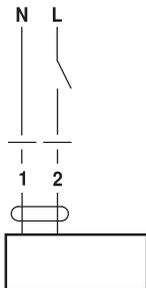
NF24A  
SF24A



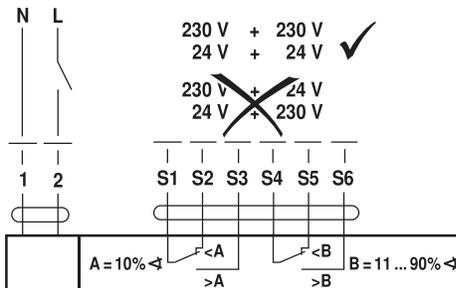
NF24A-S2  
SF24A-S2

230 V + 230 V ✓  
24 V + 24 V ✓  
~~230 V + 24 V~~  
~~24 V + 230 V~~

AC 230 V ⚠



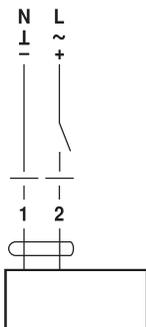
NF230A  
SF230A



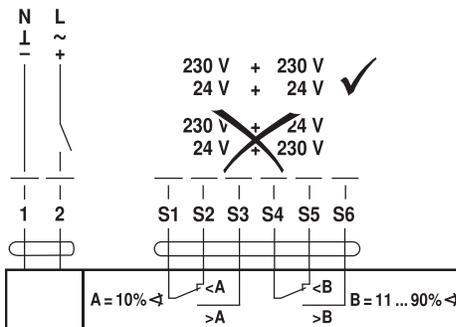
NF230A-S2  
SF230A-S2

230 V + 230 V ✓  
24 V + 24 V ✓  
~~230 V + 24 V~~  
~~24 V + 230 V~~

AC 24 ... 240 V / DC 24 ... 125 V ⚠

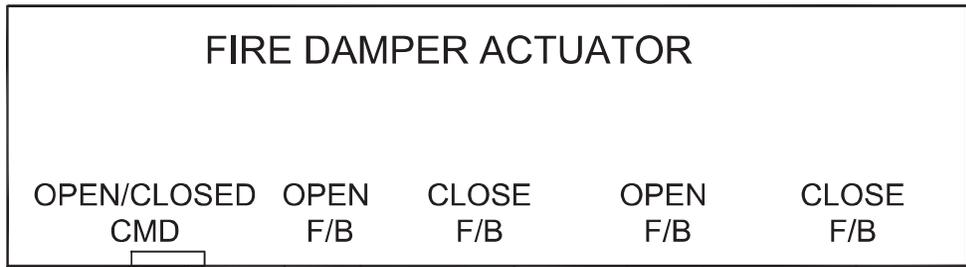


NFA  
SFA

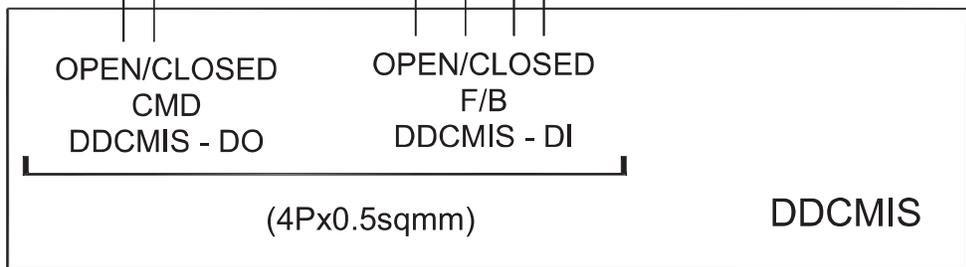
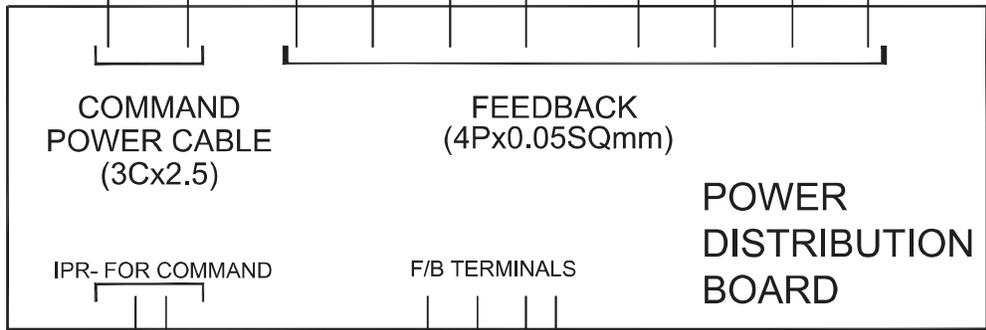
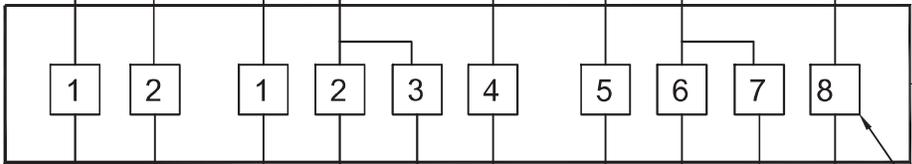


NFA-S2  
SFA-S2

230 V + 230 V ✓  
24 V + 24 V ✓  
~~230 V + 24 V~~  
~~24 V + 230 V~~



0.75 SQmm



TYPICAL INTERFACE DETAIL FOR FIRE DAMPER