NTPC LIMITED

MOUDA, KORBA, BHILAI TPS

(FGD SYSTEM PACKAGE)

TECHNICAL SPECIFICATION

FOR

HVAC SYSTEM

SPECIFICATION NO.: - PE-TS-444/466/468- (571-013)-A001

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

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THIS TECHNICAL SPECIFICATION CONSISTS OF TWO SECTIONS:

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INTENT OF SPECIFICATION

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 as per details in different sections / volumes of this specification and various pre award agreements for following FGD System package.

- **2x250 MW NSPCL BHILAI TPP**
- **3X200MW + 4X500MW KORBA TPP**
- **2x500 MW NTPC Mouda**

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

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.

SECTION: I

SUB-SECTION: B

PROJECT INFORMATION

1.00.00 BACKGROUND

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.
The present proposal is for implementation of FGD system in the stage-III (1x500MW) of Korba STPP for reduction of SOx emissions.

1.01.00 **LOCATION AND APPROACH**

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 & Korba and is approximately 110 kms from Bilaspur and 10 kms from Korba town.

Vicinity plan of the proposed project is placed at **Annexure –I.**

1.02.00 **LAND**

Wet Limestone Forced Oxidation FGD equipment shall be installed within the existing station premises.

1.03.00 **WATER**

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.

1.04.00 **Coal Quality Parameters / Fuel Oil Characteristics & Plant Water details:**

(i) The Coal quality parameters and Fuel Oil characteristics are indicated in Table-1 & Table-2 respectively below.

(ii) Process water:
Process water quality is CW Blowdown based on the COC indicated in Table-4.

(iii) Clarified water:
Clarified water quality is indicated in Table-4.

(iv) DM water for Equipment cooling water system.

1.00.00 **BACKGROUND**

NSPCL has setup coal based thermal power plant of 2X250 MW capacity at BHILAI in Chhattisgarh primarily to meet captive power requirement of SAIL, NSPCL is supplying balance power to the beneficiaries in the western region. Both the units have been commissioned during 2008-09 and commercialized during 2009-10.

1.01.0 **LOCATION AND APPROACH**

The NSPCL site is located at District Durg, Bhilai (East) having latitude and longitude of 21° 11' 25" N and 81°26'05" E, respectively. The nearest railhead on the Raipur- Nagpur section of South Eastern Central Railway is Bhilai which is approx. 4 km from site. The site is approachable from National Highway -6 which connects the site with both Durg and Raipur. The nearest- airport is at Raipur, about 35kms away from the site. The nearest town is Bhilai, approx. 10 km from the project site.

Vicinity plan of the proposed project is placed at **Annexure-I**.

1.02.00 **LAND**

Total land area for plant & dyke is 659 acres. Ash Dyke is constructed in 221 Acre land.

1.03.00 **WATER**

The make- up water requirement for the plant has been met from the existing system of Bhilai CPP-1, CPP-2 and BSP i: e Maroda Tank-II, which is fed by Tandula Main Canal.

1.04.00 **Coal Quality Parameters / Fuel Oil Characteristics& Plant Water details:**

(i) The coal quality parameters and Fuel oil Characteristics are indicated in Table-1 & Table-2 respectively below.

(ii) Process water: Process water quality based on COC given in Table-4.

(iii) Clarified water: Clarified water quality is indicated in Table-4.

(iv) DM water for Equipment cooling water system. DM water quality is indicated in Table-5.

1.05.00 **STEAM GENERATOR AND ESP DATA:** Refer Table-6

1.06.00 Drawings are enclosed as per Table-7 for initial overview to the Bidder.

2.00.00 **NOT USED**

3.00.00 **Capacity**

Present proposal : 2 X 250 MW

4.00.00 **Metrological Data**

The metrological data from nearest observatory is placed at **Annexure-II.**

INTRODUCTION

1.00.00 BACKGROUND

Details of proposed Stage / Units

Project name	: Mauda Super Thermal Power Project
No. of Units x capacity	: 2x500 MW
Project setting up by	: NTPC LTD.

Mauda Thermal Power Project (Coal based) to be set up by NTPC near Mauda in Nagpur district of Maharashtra State. The capacity of the project to be executed under this contract is 1000MW comprising of 2X500MW units. Coal, water and land commitments have been accorded by the respective state and/or central Govt. agencies.

1.01.0 LOCATION AND APPR0ACH

The proposed power project of MAUDA THERMAL POWER PROJECT is located in Mauda Tehsil, Nagpur district of Maharashtra, having latitude and longitude of 21°-10'-50" N and 79°-23'-52" E respectively. It is bound by villages Lapka and Kumbhari. Mauda town is located at a distance of approximate 4 Kms. from the plant. Chacher railway station on Nagpur - Kolkata Broad Gauge (BG) section of South Eastern Railway (Main Line), is 8 Kms away.

Vicinity Plan of the project is placed at Annexure-I

1.02.00 Land

Total 1580 Acres of land is used for plant, ash disposal, township, railway siding and other facilities. In-principle land availability clearance was given by Collector, Nagpur vide letter dtd. 27.03.2001.

1.03.00 Water

Water requirement for the project is met from pondage created on river Wain Ganga (by construction of dam) near Gosikhurd by Govt. of Maharashtra.

Ministry of Industries, Energy and Labour Department, Government of Maharashtra vide letter dated 10.12.2002 has given in-principle consent for making available the required water for the proposed project.

Make up water requirement for this project is about 4400 Cu.M/hr with ash water recirculation system and about 5800 Cu.M/hr with once through ash water system.

SECTION: I

SUB SECTION: C

TECHNICAL SPECIFICATIONS

SECTION: I

SUB-SECTION: C 1

SPECIFIC TECHNICAL REQUIREMENT

1. FUNCTION

The purpose of the system is to provide HVAC system for different areas of MOUDA, KORBA, BHILAI TPS - FGD (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 -ll, 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-ll 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-ll 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-ll, Sub-Section 8. Any deviation in Civil aspect shall not be acceptable.

- 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)-A303) for Korba TPS, (drg. No. PE-V0-468-(571-13000-A)-A303) for Bhilai TPS, (drg. No. PE-V0-444-(571-13000-A)-A303) for Mouda TPS..
- 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.

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-ll. 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 - ll, 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	Axial Fan	OEM	
10.0	Propeller Fan	Crompton Greaves	
11.0	Thermal Insulation	Armacell/ A Flex/ U.P. Twiga/ Lloyd	
12.0	GI Sheet	SAIL/TATA/JSW	
13.0	Filters	As per Approved Vendor List	
14.0	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.
- 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
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

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) Drain piping within room up to the drain point to be provided by the Vendor.

10) Tools & tackles as required for regular maintenance shall be supplied by Vendor.

11) Pressure gauges shall have provision for air venting.

12) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied (as per attached instrumentation installation diagram)

13) 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.

14) 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.

15) 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.

16) 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.

17) 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.

18) 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.

19) 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.

20) Supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.

21) All codes and standards shall be as per contract specifications

22) 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.

23) Part of the Modular type Unitary air filtration unit of Capacity 1,10,000 CMH, 65MM Static to be supplied by the bidder for Mouda is given below.

S. NO.	MATERIAL DESCRIPTION	QTY & UOM	SUPPLY STATUS
A	UAF Unit base Frame (MS Channel)	1 Lot*	**Already Supplied, available at Site**
B	UAF Unit Tank along with support structure	1 Lot*	
C	Fresh Air Intake Louvers along with fixing structure, Bird Mesh, etc.	1 Lot*	
D	Air Distribution Plate	1 Lot*	
E	Piping with fittings for water distribution inside water spray chamber. Tank over flow & drain, water level makes up, etc.	1 Lot*	
F	Piping along with fittings and valves, etc. for Tank over flow & drain, water level make up, connections	1 Lot*	
G	UAF Unit Enclosures (wall and roof double skin type - 25mm) along with accessories such AIR Tight Door with Inspection Glass & Limit Switch for various chambers, Marine Lamps, etc	1 Lot*	**To be supplied by the bidder.**
H	Water Repellent filter with support structure	1 Lot*	
I	Mist Eliminator, over flow control float assembly, outlet screen, cat walk, etc.	1 Lot*	
J	Water recirculation Pump with motor with support structure frame	1 Set*	
K	Pump's suction and discharge piping with fittings, strainer, valves, etc.,	1 Lot*	
L	Water Spray Nozzles	1 Lot*	
M	Centrifugal fan with motor assembly along with accessories such as belt, vibration isolators, etc.	1 Set*	
N	Flexible Joint (canvas) at Centrifugal fan discharge connection.	1 Lot*	
O	Volume Control Damper (VCD) at Centrifugal Fan Discharge.	1 Set*	

Bidder to refer TDS and GA Drawing of the UAF enclosed elsewhere in the specification for specific details. Any other items other than above required for completion of UAF system is deemed to be included in the bidder scope.

5. EXCLUSIONS

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

a) E&C for HVAC System

b) Construction of air handling unit room, foundations for HVAC equipment's.

c) False ceiling, drop ceiling.

d) 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.

e) Provision of drain traps / points,

f) For Electrical scope, refer Electrical scope matrix sheet.

g) DCS Control panel for Operation and control of HVAC System. However, all logic for implementation of control and monitoring from DCS shall be provided by successful bidder during detail engineering.

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

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.

1.02.00 **Redundancies of equipments:**

100% standby unit shall be kept for FGD control room, analyzer room/Prota cabin (if required) and other air conditioned offices/areas.

2.00.00 VENTILATION SYSTEM

a) **General**

The scope includes Engineering, Supply, Construction, Erection, Testing and Commissioning for Complete Ventilation system consisting of Modular type Unitary air filteration 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.

b) **Non-A/C areas of F.G.D Control Room Building**

Minimum One (1) nos. of Evaporative type Unitary Air Filtration (UAF) unit (of metallic construction- modular type) of suitable capacity with all accessories, DIDW centrifugal fan (1 x 100%), circulating water pump (1 x 100%), etc. as detailed out in technical specification shall be provided.

c) **Miscellaneous areas:** All other areas like Limestone Grinding system building, Gypsum dewatering building, Recirculation pump & Oxidation blower/compressor building etc & all other non-air conditioned areas covered under this package shall be ventilated by a combination of supply/exhaust fans and fresh air in-take / back draft louvers. For ventilation of Battery rooms and Oil rooms, fans with flame proof motor shall be used. Further, toilets shall be provided with propeller type exhaust air fans.

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.

Note 2: If open shed is envisaged for any facility, then in that case no mechanical ventilation is required.

d) Supply of Mandatory spares as specified.

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

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.

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.

4.00.00 **General**

i. All associated Civil & structural work for air conditioning and Ventilation system and compressed air system.

ii. Set of commissioning spares as may be required during erection and commissioning.

iii. One (1) set Special tools and tackles required for maintenance of all the Mechanical, Electrical and C & I equipment under the scope of bidder.

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.

v. Any additional items required to make the system complete.

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.

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.

Corrosion protection painting for all equipment / items by Bidder as detailed in relevant clauses of technical specification.

6.00.00 AIR CONDITIONING SYSTEM

GENERAL REQUIREMENTS

1. All equipments shall be located indoor unless otherwise agreed to by the Employer. The equipment and layout shall generally be in accordance with the General Layout Plant drawings.
2. The layout of all equipment and accessories shall be developed in a way to facilitate easy accessibility and maintenance of all equipments.
3. Each equipment shall be provided with suitable lifting arrangement, e.g. Lifting lugs, eye bolts, etc to facilitate maintenance.

6.01.00 **DESIGN PHILOSOPHY FOR AIR CONDITIONING**

1. Design ambient conditions for all air conditioning system shall be as per **Appendix-A.**
2. All equipments of Air Conditioning system shall be designed for continuous duty.
3. All air conditioned areas shall be maintained at 24 deg. C ± (plus or minus) 1 deg. C and relative humidity of 50% ± (plus or minus) 5%.
4. The fresh air quantity for air-conditioned areas of FGD Control Room etc. shall be 0.45 M^3/minutes/person or 1.5 air change per hour whichever is greater. Fresh air fan capacity shall be minimum 10% of the total CMH value of working indoor units.
5. Lighting load shall be minimum 2 Watts/Sq. feet.
6. The occupancy for general area shall be minimum one person per 10 Sq. M and for conference room the same shall be one per 3 Sq.M. In the equipment rooms etc, the occupancy may be one person per 25 Sq.M (Minimum).
7. In Air conditioning system for FGD Control Room, return air shall be routed back to AHU room through plenum space.
8. The supply and return air ducts shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls & floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts in control panel of A/C plant and further wiring upto fire alarm panels shall be done by Bidder.

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.
10. Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec.
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.
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

    i) Non A/C area is located just above the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of A/C area.

    ii) Non A/C area is located just below the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of Non A/C area.

    iii) Underneath the ceiling of AHU room located below the A/C area or exposed to Atmosphere.
13. AHU's shall be provided with two stage of filteration i.e. pre and fine filter. All fresh air supply shall also be filtered using pre and fine filter.
14. A minimum design margin of ten (10) % shall be considered in design of A/C Plant Capacity for each area.
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/packaged A/C shall be provided. If the air conditioning load is less than 5TR, then Hi-wall Split/Cassette air conditioner shall be provided.
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.

6.02.00 **REDUNDANCY OF EQUIPMENTS**

6.02.01 Redundancy of various A/C system equipments shall be as follows:

a) FGD Control Room Building

i) Mouda - 2x100% ACCU, Bhilai -2x100% ACCU, Korba - 6x33% ACCU

ii) Mouda - 2x100% AHU With VFD, Bhilai -2x100% AHU, Korba - 6x33% AHU

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

c) Fresh air fans shall be 1 x 100 % Capacity for each AHU room.

6.03.00 **DESIGN PHILOSOPHY – Ventilation System**

1. Air changes per hour in evaporative/ mechanically ventilated areas shall be as follows:

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

2. However in areas producing lot of heat, temperature shall be the criteria as follows:-

a) Inside temperature shall be minimum 3 deg.C below the design ambient temperature during summer for evaporative cooled areas.

b) Inside Temperature shall be maximum 3 deg.C above the design ambient temperature during summer for mechanically ventilated areas.

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.

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.

3. All ventilation systems shall operate on 100% fresh air. All mechanically ventilated areas shall be positively ventilated by means of supply air fans fitted with filters and exhaust fans for ventilation of heat generating areas combination of supply air fans with exhaust air fans shall be provided. MCC / switchgear and cable gallery areas shall be provided with gravity operated back draft dampers in association with supply air fans in order to maintain positive pressure. Battery rooms and other fumes/odour generating areas shall be negatively ventilated by means of exhaust air fans / roof exhausters and intake louvers. All other areas like pump house, Blower/compressor house (if any), etc shall be positively ventilated by a combination of supply air fan and exhaust air fan. Supply air fan catering for electrical areas (MCC & Switchgear rooms) shall be provided with pre-filters and fine filters and for other areas shall be provided with pre-filter only. For Positive ventilation CFM of exhaust air shall be 60% of CFM required for supply air. Similarly for negatively ventilated area, CFM of supply shall be 60% of total CFM exhaust.
4. All the equipments of Ventilation system shall be designed for continuous duty.
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

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.

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.
7. For pumps, continuous motor rating (at 50^{O}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^{O}C ambient) shall be atleast 10% above the maximum load demand at the design duty point.
8. Supply air fans, exhaust air fans & ventilations of each area shall be provided with local starter panels.

Appendix-A

Outside Design Ambient condition to be considered for Air Conditioning system and Ventilation System for various project/station are as under.

Location	Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)
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

NSPCL Bhilai (2x250)	Summer	43.3	25
	Monsoon	33.3	28.3
	Winter	10	7.2
NSPCL Rourkela (1x250)	Summer	43	25.6
	Monsoon	30.6	27.8
	Winter	10	7.2

SUB-SECTION-I-M2

AIR CONDITIONING & VENTILATION SYSTEM

1.00.00 GENERAL

1.01.00 This section of specification covers details of system specifications, detailing the areas to be air conditioned, basis of design, brief description of the system, equipment and services to be furnished by bidder.

The Design, Engineering, Supply, Construction, Erection, and Testing & Commissioning of all the equipments & works listed here shall be on the basis of single point responsibility in bidder's scope of work for satisfactory completion of the system in all respect.

2.00.00 AREAS TO BE AIR CONDITIONED

2.01.00 The areas to be air-conditioned shall be as follows:

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

b) Cassette and Hi-wall Air-conditioners for Other auxiliary control room /control room buildings not listed above but covered in the scope of Bidder.

3.00.00 AREAS TO BE VENTILATED

3.01.00 (i) Modular type UAF units of suitable capacity (1x100%) shall be provided for non-air-conditioned area of FGD control room building considering design philosophy for evaporative type ventilation system mentioned in sub section-V (salient design data and sizing), Part-A of technical specification section VI. All non-air-conditioned area of FGD (cable gallery& MCC room shall be positively ventilated and exhaust shall be through gravity damper.

(ii) Mechanical Ventilation (using Roof extractors/ Supply and/or Exhaust fans) shall be provided for various other areas/buildings in the scope of bidder as under:

a) Grinding system building
b) Gypsum dewatering building
c) Recirculation pump & Oxidation blower/compressor building.

(iii) Toilets etc in above building (i) & (ii). Any other area not listed above but covered in the scope of Bidder.

(iv) For other miscellaneous areas/ buildings not listed above but covered in the scope of Bidder, mechanical type ventilation system using Supply and/or exhaust air fans/ roof exhausters shall be provided.

3.02.00 All non-air-conditioned areas covered under this package shall be ventilated by a combination of supply/exhaust fans and fresh air in-take / back draft louvers as detailed below:

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

condensing temperature and shall be indicated.

4.02.00 **Air Handling Unit (AHU)**

4.02.01 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.

4.02.02 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.

4.02.03 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.

4.02.04 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.

4.02.05 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.

4.02.06 **Centrifugal fan for AHU**

a)	Fan Type	:	Double Width Double Inlet (DWDI) Centrifugal Type
b)	Fan impeller	:	Backward curved blades
c)	Casing material	:	GI /Mild steel with minimum thickness of 3 mm.
d)	Impeller material	:	Carbon steel
e)	Shaft	:	EN 8 Steel

	f)	Fan bearings	:	Self aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours.
	g)	Critical speed	:	First critical speed of rotating assembly shall be at least 25% above the operating speed.
	h)	Drive	:	Motor driven with removable belt guard. Motor driven with removable belt guard. Motor rating (at 50 deg.C ambient) shall be atleast fifteen percent (15%) above the maximum load demand of drives at the design duty point.
	i)	Fans	:	For AHUs of capacity 50,000 CMH and above, Bidder may offer two (2) Nos. centrifugal fans of equal capacity for each AHU provided all such AHUs are accommodated within the space identified by the Employer.

4.02.07 **Mixing Box:**

Mixing box shall be complete with fresh and return air dampers. Mixing box shall be provided whenever the return air is ducted back to the AHU. Further, wherever return air is led back directly to AHU room, no mixing box is required.

4.02.08 **Pan Humidifier:**

Pan humidifier shall be made of 22 gauge SS 304 tank, duly insulated with 25 mm thick resin bonded fiber glass insulation (min. 24 Kg/m3 density) with 0.5 mm GSS cladding. The humidifier shall be complete with stainless steel immersion heaters, safety thermostat, float valve with stainless steel ball, sight glass, overflow and drain connections, steam outlet nozzle and float switch. Step controller shall be provided for switching on / off heater banks as per system requirement.

4.03.00 HI-WALL SPLIT/CASSETTE AIR-CONDITIONERS

4.03.01 Hi-wall Split/cassette air conditioners shall in general consist of the following:

i) Casing

ii) Hermetically sealed rotary/scroll Compressor

iii) Condenser and condenser cooling fan

iv) Evaporator along with fan

v) Cooling coil

vi) Filters

vii) Piping, valves, refrigerant strainer, etc.

viii) Controls, instruments, control panel/starter panels.

ix) Vibration isolator pads, etc as required.

x) Refrigerant as per manufacturer practice.

4.03.02 Indoor unit of Ceiling Mounted Cassette Type Unit (Multi Flow Type):

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.

Unit shall have four way supply air grills on sides and return air grill in center.

Each unit shall have high lift drain pump and very low operating sound.

4.04.00 **SPLIT/PACKAGED AIR CONDITIONERS**

4.04.01 Split/packaged air conditioners shall in general consist of following:

I. Casing
II. Compressor
III. Condenser
IV. Evaporator and condenser cooling fan
V. Cooling Coil
VI. Filters
VII. Piping, Valves, refrigerant strainer etc.
VIII. Control, instruments, control panel/starter panels.
IX. Vibration isolator pads, ducting (if applicable) etc as required.

5.00.00 EQUIPMENT DESCRIPTION - VENTILATION SYSTEM

5.01.00 Unitary Air Filtration

5.01.01 Each modular unitary air filtration shall consist of Casing, Tanks, Fans, Distribution plates, Moisture eliminator and water repellant type nylon filter with frame and support, Header and standpipe with support, Spray and flooding type nozzle. Screen type suction strainer, Pumps, Necessary controls & Instrumentation, and all other required accessories.

5.01.02 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.

5.01.03	The unitary air filtration tank shall be fabricated from MS plate of minimum 6 mm thick and inside and outside surface of the tank shall be spray galvanized **(minimum 60 microns DFT).** Minimum depth of the tank shall be 600 mm. Tank construction shall be such that the suction screen can be replaced while the unit is operating. Tank shall be provided with overflow, drain with valve, float valve makeup connection with a gate valve backup, quick fill connection with globe valve etc. The overflow pipe shall be connected to drain pipe after isolating valve on drain pipe.
5.01.04	The distribution plate shall be fabricated out of 18G galvanized steel sheets & galvanized steel angle supports with minimum 50% free area.
5.01.05	Unitary air filtration shall be one-bank construction. All header and stand pipes shall be galvanised. Cat walks of suitable width shall be provided for maintenance of nozzle, filter etc.
5.01.06	The spray nozzles shall be of brass or bronze with chrome plating and shall be self cleaning type. The nozzle shall be designed to produce fine atomised spray and shall be properly spaced to give a uniform coverage of the air washer section. The pressure drop through the nozzle should be in the range of 1.4 to 2.4 Kg/cm2.
5.01.07	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 galvanised steel or PVC construction and shall be complete with suitable drip tray and drain pipe.
5.01.08	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.
5.01.09	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.
5.01.10	The specification for centrifugal fans shall generally be as indicated below. However, the fan shall be of DIDW type for UAF unit.
5.01.11	Saturation efficiency of Unitary Air Filtration units shall be minimum 60%.
5.02.00	**Centrifugal Fan**
5.02.01	The casing shall be of welded construction fabricated with heavy gauge galvanised sheet steel or MS sheet with spray galvanization (**minimum** 60 micron DFT). The minimum thickness of casing shall be 3 mm. It shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed air-tight. Split casings shall be provided on larger sizes of fans. Casing drain with valves shall be provided wherever required. 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.

5.02.02	The bearing shall be self aligning, heavy duly ball, roller or sleeve bearing. They shall be adequately supported. They shall be easily accessible and lubricated properly from outside.
5.02.03	Inlet guard shall be spun to have a smooth contour. Inlet screen, if provided, shall be of galvanised wire mesh of 25 mm square.
5.02.04	Base plate with necessary number of spring type vibration isolators or ribbed neoprene rubber pad or cushy foot mounting shall be provided. The vibration isolators should have a minimum of 70% efficiency.
5.02.05	The first critical speed of the rotating assembly shall be at least 25% above the opening speed.
5.02.06	The fans shall be provided with V-belts and sheaves. All belts shall be sized for 150% rated HP. All V-belt shall be equipped with removable belt guards that do not impede the air flow to the fan inlet. There shall be a minimum of two belts per drive. Motor rating (at 50 deg.C ambient) shall be atleast fifteen percent (15%) above the maximum load demand of drives at the design duty point.
5.03.0	**Roof Ventilators (If applicable)**
5.03.01	The roof extractors shall be “COWL” type.
5.03.02	Impeller shall be of axial flow type, cast Aluminium in one piece and dynamically balanced. Casing shall be heavy gauge sheet steel construction of 3 mm thick for impeller upto 750 mm diameter and 5 mm for fans with impeller of diameter 750 and above. In casing, access door with locking arrangement be provided.
5.03.03	The cowl shall be designed for weather protection of the fan also inside of the roof on which the extractor is installed. Galvanised bird screen of 15 mm Square be provided with the cowl. All accessories, steel supports as required will be provided.
5.03.04	The speed of the fan be limited as per limitation given above for axial fans.
5.03.05	All accessories rain protection exhaust hood, transformation piece, vibration isolators, steel supports vibration isolators, bird screen, etc. as required shall be provided.
5.03.06	The vibration level for fans shall be as per ISO: 14694.
5.04.00	**Centrifugal Pumps**

a)	Type	:	Horizontal Centrifugal, Axially or radial split type casing pump or end suction, top discharge horizontal centrifugal pump
b)	Impeller	:	Closed type
c)	Material of Construction		
	i) Casing	:	2% Ni Cast Iron : IS:210 Gr. FG-260
	ii) Impeller	:	Bronze IS:318 Gr-2

	iii) Wearing rings	:	Bronze
	iv) Shaft	:	SS 316
	v) Shaft sleeve	:	SS 316
	vi) Lantern ring	:	Brass / Bronze
	vii) Packing	:	Asbestos free
	viii) Base Plate	:	Carbon steel as per IS:2062
	ix) Speed	:	Maximum 1500 rpm
	x) Other requirements	:	To refer to **Annexure-I** titled "Horizontal Pumps" of this sub section.

5.05.0 Axial Fans

5.05.01 These fans shall have fixed / variable pitch cast aluminum blades of aerofoil design.

5.05.02 The fan casing shall be of heavy gauge sheet steel construction.

5.05.03 Necessary rain protection cowl, inlet and outlet cones, bird protection screen, adjustable damper, vibration isolators, back draft dampers etc. shall be provided.

5.05.04 The speed of the fan shall not exceed 960 rpm for fan with impeller diameter above 450 mm and 1400 rpm for fan with impeller diameter 450 mm or less. However for fans having static pressure of 30 mm WC or above the speed of the fan shall not exceed 1440 rpm for fan with impeller diameter of above 450 mm and 2800 rpm for fan with impeller diameter of 450 mm or less. The first critical speed of rotating assembly shall be atleast 25% above the operating speed.

5.05.05 All other accessories like supporting structure etc. as required shall be provided.

5.05.06 Fans of capacity 1000 m^3/hr & lower shall be of propeller exhaust type.

6.00.00 BALANCE EQUIPMENT SPECIFICATION

6.01.00 **Material of Construction for Piping & Fittings**

a)	Piping for Chilled and Condenser water lines	:	Heavy grade-IS:1239 or Equivalent upto150 NB and IS:3589 or Equivalent for pipes beyond 200 NB with thickness as indicated in **Annexure-II**
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).
c)	Drain piping	:	Same as (a) above & galvanized as per IS:4736.

	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. 2) For sizes 50 NB and below, the material shall conform to ASTM A-105. 3) All steel flanges shall be of slip on type and shall conform to ANSI B 16.5 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. 5) Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B31.5
6.02.00	**VALVES**
6.02.01	Valves shall have full sizes port and suitable for horizontal and as well as vertical installation.
6.02.02	Valves for regulating duty shall be of globe type suitable for controlling throughout its lift.
6.02.03	All safety /relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.
6.02.04	Valves shall be furnished with back seating arrangement for repacking while working under full working pressure.
6.02.05	Manual gear operators be provided for valves of size 200 NB and above.
6.02.06	All valves shall be supplied with companion flanges, nut, bolts & washers, etc.
6.02.07	The refrigerant line valves shall have steel or brass body with TEFLON gland packing. The construction of disc shall be either globe or angle type. The valve seat shall have white metal lining or equivalent.
6.02.08	Gate valves shall be of Cast Iron body (confirming to IS:210 Gr FG 220/equivalent) for sizes 65 NB and above conforming to fIS :14846. Gun Metal construction for sizes less than 65NB shall be as per IS:778. Butterfly valves shall conform to latest revision of BS:5155 or equivalent standard of required class/rating.
6.03.00	**AIR FILTERS**
6.03.01	**Pre Filter** 1) Type : Flange / Cassette 2) Pre-filter shall contain washable non-woven synthetic fiber or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium

expanded metal on exit side or G.I. wire mesh on both sides.

3) **Other requirements : (as applicable)**

a) Suitable aluminium spacers be provided for uniform air flow;

b) Casing shall be provided with neoprene sponge rubber sealing.

c) Capable of being cleaned by water flushing.

d) Density of filter medium shall increase in the direction of air flow in case of metallic filter.

e) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.

4) **Efficiency :**

Average arrestance of 65 - 80 % when tested in accordance with BS:6540/ASHRAE – 52 – 76 / EN-779.

5) Minimum thickness : 50 mm

6) Face Velocity : Not more than 2.5 m/sec.

7) Pressure drop : Initial pressure drop - Not to exceed 5.0 mm WC at rated flow.

Final pressure drop - Upto 7.5 mm WC.

8) Location : a) At the suction of each AHUs

: b) At the suction of each Fresh air fan

6.03.02 **Fine Filters (Microvee type)**

1) Type : Flange / Cassette

2) Fine filter shall contain washable non-woven synthetic fibre or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides.

3) Other requirements :

a) A neoprene sponge rubber sealing shall be provided on either face of the filter frame.

b) Capable of being cleaned by air or water flushing.

c) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.

	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

6.04.04 **Duct Fabrication and Supports:**

a) Duct fabrication shall be as per the latest relevant BIS/SMACNA standard.

b) Ducts for A/C system may be **site fabricated or factory fabricated**.

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.

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.

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.

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.

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.

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.

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

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

6.04.06 **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.

6.05.04	Supply air grills shall be of double deflection type and return air grills shall be of single deflection type.
6.05.05	All volume control (VC) damper shall be operated by a key from the front of the grills/diffusers and shall be of GI sheet.
6.05.06	The thickness of VC dampers shall be of minimum 20 gauge and thickness of louvers shall be of minimum 22 gauge.
6.05.07	Suitable vanes shall be provided in the duct collar to have uniform and proper air distribution. Bank of Baffles wherever required shall also be provided.
6.05.08	Fire dampers shall be motor operated type and shall have fire rating of minimum 90 minutes.
6.05.09	All plenum chambers of connections to fans, dampers etc shall be constructed in 18 gauge GS sheet and supported on MS angle frames.
6.05.10	All ducting surfaces coming in contact with corrosive fumes or gases shall be painted with three coats of epoxy paint over a coat of suitable primer.
6.06.0	**Thermal and Acoustic Insulation**
6.06.01	**A) <u>Application with Glass Wool / Rockwool</u>**
	(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) <u>Application with Nitrile Rubber</u>
	(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.
	C) <u>Application with Polyurethane Foam & Polyisocyanurate Foam</u>
	i) All surfaces to be insulated shall be cleaned.

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 or	Roll /Slab	50	F-3
		Closed Cell Elastomeric Nitrile Rubber	sheet	19	As per manufacturer std.
		or Polyisocyanurate Foam	Slab	30	F-3
2.	Refrigerant (Suction and liquid lines)	Closed Cell Elastomeric Nitrile Rubber	tube	19	As per manufacturer std.
		or Rigid Polyurethane Foam	Pipe Section	50	F-1 (a)
3.	AHU drain pipe	Closed Cell Elastomeric Nitrile Rubber	tube	19	As per manufacturer std.
		or Rigid Polyurethane Foam	Pipe Section	50	F-1 (a)
4.	AHU condensate pan (insulation	Mineral wool or resin bonded glass wool	Slab	25	As per manufacturer std.

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)

Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
		Foam			

6.06.03 **Specification for insulation shall be as follows: -**

Insulation Material	Code	Thermal conductivity (w/m/^{o}C	Density Kg/m^3
Resin bonded glass wool	IS:8183	0.049 at 50^{o}C 0.043 at 50^{o}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^{o}C	144
Closed Cell Elastomeric Nitrile Rubber		0.036 at 20^{o}C	40 – 60
Polyurethane Foam Polyisocyanurate Foam	IS12436	0.03 at 50 ^{o}C 0.03 at 50 ^{o}C	34 $\pm$ 2 34 $\pm$ 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)	**Finish F-1 (with Resin Bonded Glass Wool/Resin Bonded Mineral Wool)**
	Step-1 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.
	Step-2 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.

	Step-3 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.
aa)	**Finish F-1(a) (With Polyurethane Foam & Polyisocyanurate Foam)** Wrapping of two layers of 7 mil 10 x 10 mesh glass cloth dipped in suitable adhesive such as SR 998 or Loid Bond 130 equivalent
b)	**Finish F-2** Step-1 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.
	Step-2 Same as Step-2 of Finish F-1 above.
	Step-3 Same as Step-3 of Finish F-1 above.
c)	**Finish F-3** Step-1 Same as Step-1 of Finish F-2 above
	Step-2 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.
d)	**Finish F-4** Step-1 Same as Step-1 of Finish F-1 above. Step-2 Same as Step-2 of Finish F-1 above. Step-3 Same as Step-3 of Finish F-1 above. Step-4 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. Step-5 After the above treatment, 22G Aluminium sheet cladding, properly stiched at all joints shall be provided over the external surface.
dd)	**Finish F-4(a) (With FR Closed Cell Chemically Cross Linked Polyethylene)** Application of aluminium sheet 22G cladding to be provided over the XLPE insulating material. Cladding sheet is held in position with SDST screws @ 150 mm C/c over tongue-in-groove joints applied with a felt for sealing joint against water ingress. All sheet joints to be done in a manner to shed water.

6.06.05 For all inspection covers and hatches on equipment, pump casing, valve bodies and flanges (100 mm and above), insulation shall be applied so as to facilitate removal without minimum damage to the insulation by encasing the insulation in 24 gauge GI box or 22 gauge Aluminium sheet metal boxes which are bolted together around the equipment. However continuity of the vapour seal between the static and removable portions of the insulation is to be maintained.

6.06.06 **ACOUSTIC INSULATION**

a) All ducts up to a distance of 5 meters from AHU shall be acoustically lined from inside with 25 mm thick resin bonded glass wool of 48 Kg/Cu.M. density and 30 gauge perforated aluminium sheet having 5 mm dia perforation at 8 to 10 mm centre-to-centre distance. Insulation shall be fixed on wooden frame of 600 x 600 mm dimension.

b) Fibre glass tissue sheet shall be applied over the outer surface of insulation before applying perforated aluminium sheet. Application of acoustic insulation shall be inline with the requirements specified above.

7.00.00 PLANT CONTROL

7.01.00 Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from employer. The descriptions in the sub-sections of the control & instrument sections shall also be referred to.

7.02.00 **Control Scheme for Air-Conditioning System**

7.02.01 Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of air conditioning and ventilation system as per manufacturer's standard practice. Control and monitoring of air conditioning and ventilation system from FGD control system is also acceptable.

7.03.00 **Air Handling Unit**

a) Humidity sensor and gyserstat located in the return air duct shall actuate the PAN humidifier to obtain the desired degree of humidification.

b) Humidity and temp. sensor shall be provided and interlocked in steps with winter heater / re-heater / strip heaters for monsoon and winter re-heating or heating as the case may be.

c) Heater banks shall be interlocked with the running of AHU, temperature of return air, humidity of return air and safety thermostat (airstat - located in front of the each heater in the supply air duct)

d) AHU shall be started either locally or from the main control room of AC system by means of Remote / Manual selection facility.

e) The closure of fire dampers, automatic tripping of AHU fans and fresh air fans shall be interlocked with Fire Detection System.

7.05.00 **Cassette /Hi-wall Split Air Conditioners**

Control and interlocks for these type of units shall be as per manufacturer's standard practice.

7.06.00	**Miscellaneous Control Requirements** a) The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally. b) Relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall made be available in FGD control system.
8.00.00	**PAINTING:**
8.01.00	All the Equipments shall be protected against external corrosion by providing suitable painting.
8.02.00	The surfaces of stainless steel, Galvanized steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The Contractor shall clean the external surfaces and internal surfaces before Erection by wire brushing and air blowing. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting, etc. as per the agreed procedure.
8.03.00	For all the steel surfaces (external) exposed to atmosphere (outdoor installation), one(1) coat of red oxide primer of thickness 30 to 35 microns followed up with three (3) coats of synthetic enamel paint, with 25 microns as thickness of each coat, shall be applied.
8.04.00	For all the steel surfaces inside the building (indoor installation), One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat shall be applied.
8.05.00	For centrifugal fans - Casing shall have hot dip/ spray galvanization (**minimum** 60 micron DFT).
8.06.00	However, for all parts coming in contact with acid fumes (in Battery rooms), a coat of epoxy resin based zinc phosphate primer of minimum thickness 30 to 35 microns followed up with undercoat of epoxy resin based paint pigmented with Titanium dioxide of minimum thickness of 25 microns shall be applied and a top coat consisting of one coat of epoxy paint of approved shade and colour with glossy finish of minimum thickness of 25 microns.
9.00.00	**CODES & STANDARDS**
9.01.00	The design, manufacture and performance of equipment shall comply with all currently applicable statues, regulations and safety codes in the locality where the equipments are to be installed. Nothing in this specification shall be considered to relieve the bidder of this responsibility.
9.02.00	Unless otherwise specified, equipment shall conform to the latest applicable Indian or IEC standard. Equipment complying with other authoritative standards such as British, USA, ASHRAE etc. will also be considered if it ensures performance equivalent or superior to Indian Standard.

Annexure –I

GENERAL SPECIFICATION FOR HORIZONTAL PUMPS

1) **SCOPE**

This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.

2) **CODES AND STANDARDS**

The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

3) List of Applicable Standards.

IS : 1520 : Horizontal Centrifugal Pumps for clear cold fresh water

IS : 5120 : Technical requirements of roto dynamic special purpose pumps

API : 610 : Centrifugal pumps for general refinery service.

IS : 5639 : Pumps Handling Chemicals & corrosion liquids

IS : 5659 : Pumps for process water

HIS : Hydraulic Institute Standards, USA

ASTM-1-165-65 Standards Methods for Liquid Penetration Inspection.

In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

4) **DESIGN REQUIREMENTS**

a) The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall preferably be within ± 10% of the rated design flow as indicated in data sheets.

b) The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of about 15% more than the design head.

c) Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

d) Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

Speed	Antifriction Bearing	Sleeve Bearing
1500 rpm and below	75.0 micron	75.0 micron
3000 rpm	50.0 micron	65.0 micron

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.

e) The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.

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

g) Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.

h) The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.

5) **DESIGN CONSTRUCTION**

a) Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to.

Annexure –I

b) **Pump Casing**

Pump casing shall have axially or radially split type construction as specified. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.

Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

c) **Impeller**

Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled.

The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.

d) **Impeller/Casing Wearing Rings**

Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.

e) **Shaft**

The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.

f) **Shaft Sleeves**

Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.

Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

Annexure –I

g) **Bearings**

Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished.

The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.

Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

h) **Stuffing Boxes**

Stuffing box design should permit replacement of packing without removing any part other than the gland.

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.

i) **Mechanical Seals**

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.

j) 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.

k) **Pump Shaft Motor Shaft Coupling**

The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

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

PART - C

GENERAL TECHNICAL REQUIREMENTS

GENERAL TECHNICAL REQUIREMENTS

PART - C

CONTENTS

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1.00.00 **INTRODUCTION**

This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.

2.00.00 **BRAND NAME**

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

3.00.00 **BASE OFFER & ALTERNATE PROPOSALS**

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognised that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.

4.00.00 **COMPLETENESS OF FACILITIES**

4.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.

4.02.00 All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All same standard components/ parts of same equipment provided, shall be interchangeable with one another.

4.03.00 For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.

5.00.00 **RULES, REGULATIONS, CODES & STANDARDS**

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India, NTPC rules/codes of practices as well as of the locality where they will be installed, including the following:

a) Indian Electricity Act

b) Indian Electricity Rules

c) Indian Explosives Act

d) Indian Factories Act and State Factories Act

e) Indian Boiler Regulations (IBR)

f) Regulations of the Central Pollution Control Board, India

g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India

h) Pollution Control Regulations of Department of Environment, Government of India

i) State Pollution Control Board.

(j.) Rules for Electrical installation by Tariff Advisory Committee (TAC).

(k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996

(l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998

(m.) Explosive Rules, 1983

(n.) Petroleum Act, 1984

(o.) Petroleum Rules, 1976,

(p.) Gas Cylinder Rules, 1981

(q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981

(r.) Workmen's Compensation Act, 1923

(s.) Workmen's Compensation Rules, 1924

(t.) NTPC Safety Rules for Construction and Erection

(u.) NTPC Safety Policy

(v.) Any other statutory codes / standards / regulations, as may be applicable.

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

a) Bureau of Indian standards (BIS)

b) Japanese Industrial Standards (JIS)

c) American National Standards Institute (ANSI)

d) American Society of Testing and Materials (ASTM)

e) American Society of Mechanical Engineers (ASME)

f) American Petroleum Institute (API)

g) Standards of the Hydraulic Institute, U.S.A.

h) International Organisation for Standardisation (ISO)

i) Tubular Exchanger Manufacturer's Association (TEMA)

j) American Welding Society (AWS)

k) National Electrical Manufacturers Association (NEMA)

l) National Fire Protection Association (NFPA)

m) International Electro-Technical Commission (IEC)/European Norm (EN)

n) Expansion Joint Manufacturers Association (EJMA)

o) Heat Exchange Institute (HEI)

	p) IEEE standard q) JEC standard
5.03.00	Other International/ National standards such as DIN, JIS, VDI, EN, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.
5.04.00	Not used.
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant, equipment, civil, structural and architectural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.
6.00.00	**EQUIPMENT FUNCTIONAL GUARANTEE**
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.

7.00.00 **DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS**

7.01.00 **DESIGN OF FACILITIES**

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.

7.02.00 **MAINTENANCE AND AVILABILITY CONSIDERATIONS**

Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours , clearly defining the spare parts and man-hour requirement for each stage.

Lifting devices i.e. hoists and chain pulley jacks ,etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.

8.00.00 **DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR**

8.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely

engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope.

Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated.

The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification.

A comprehensive engg and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in **Annexure-VI** to this Part-C, Section-VI of the Technical Specification.

8.03.00 The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:

8.03.01 A) **BASIC ENGINEERING DOCUMENTATION**

Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

i) System description of all the mechanical, electrical, control & instrumentation & civil systems.

ii) Technology scan for each system / sub-system & equipment.

iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.

iv) Optimisation studies including thermal cycle optimisation.

v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins.

vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.

vii) Operation Philosophy and the control philosophy of the equipments/system covered under the scope.

ix) General Layout plan of the FGD System incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope.

x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area and other areas included in the scope of the bidder.

xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.

B) **DETAILED ENGINEERING DOCUMENTS**

i) General layout plan of the FGD System.

ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.

iii) Flow diagram, process and instrumentation diagrams along with write up and system description.

iv) Performance curves for Absorber

v) Piping isometric, composite layout and fabrication drawings.

vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.

vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors.

viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like mills, fans etc. as per criteria specified elsewhere in specification.

ix) Absorber sizing calculations. Absorber performance data.

x) Mass Balance Diagram

xi) Characteristic Curves/ Performance Correction Curves.

xii) Comprehensive list of all terminal points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.

xiii) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.

xiv) Protection system diagrams and relay settings.

xv) Cables schedules and interconnection diagrams.

xvii) Cable routing plan.

xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, and installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.

xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.

xx) Sequence and protection interlock schemes.

xxi) Type test reports, insulation co-ordination study report

xxii) Control system configuration diagramsand card circuit diagrams and maintenance details.

xxiii) Detailed Control system manuals.

xxiv) Detailed flow chart for digital control system.

xv) Mimic diagram layout, Assignment for other application engg.drawings and documents.

xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the

scope of the bidder civil calculation sheets including structural analysis and design alongwith output results.

xxvii) Underground facilities, levelling, sanitary, land scaping drawings.

xxviii) Geotechnical investigation and site survey reports (if and as applicable).

xxix) Model study reports wherever applicable.

xxx) Functional & guarantee test procedures and test reports.

xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification.

xxxii) Maintenance schedule for Absorber & auxiliaries clearly indicating interval, duration if shutdown required, manhours required and tools & tackles required for maintenance.

The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.

8.03.02 **INSTRUCTION MANUALS**

The Contractor shall make first submission of instruction manual for all the equipments covered under the Contract as per agreed engineering information schedule. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in **Annexure-IV.** The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

A) ERECTION MANUALS

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tool, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection and General Safety procedures to followed during erection/installation.

h) Procedure for initial checking after erection.

i) Procedure for testing and acceptance norms.

j) Procedure / Check list for pre-commissioning activities.

k) Procedure / Check list for commissioning of the system.

l) Safety precautions to be followed in electrical supply distribution during erection.

B) OPERATION & MAINTENANCE MANUALS

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows:

1) Chapter 1 - Plant Description: To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.

(b) Functional description of associated accessories / controls. Control interlock protection write up.

(c) Integrated operation of the equipment alongwith the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).

(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.

(e) Design data against which the plant performance will be compared.

(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.

(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).

(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) Chapter 2.0 - Plant Operation: To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.

(b) Limiting values of all protection settings.

(c) Various settings of annunciation/interlocks provided.

(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode.

(e) Do's and Don'ts related to operation of the equipment.

(f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.

(g) Parameters to be monitored with normal value and limiting values.

(h) Equipment isolating procedures.

(i) Trouble shooting with causes and remedial measures.

(j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.

(k) Routine Operational Checks, Recommended Logs and Records

(l) Change over schedule if more than one auxiliary for the same purpose is given.

(m) Preservation procedure on long shut down.

(n) System/plant commissioning procedure.

3) Chapter 3.0 - Plant Maintenance- To contain the following sections specific to the equipment supplied.

(a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.

(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.

(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.

(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.

(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.

(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.

(g) Long term maintenance schedules

(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.

(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at

longer intervals to ensure trouble free operation and quantity required for complete replacement.

(j) Tolerance for fitment of various components.

(k) Details of sub vendors with their part no. in case of bought out items.

(l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.

(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.

(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.

(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

8.03.03 After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.

8.03.03 **PLANT HANDBOOK AND PROJECT COMPLETION REPORT**

8.03.03.01 **PLANT HANDBOOK**

The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including

i) Design and performance data.

ii) Process & Instrumentation diagrams.

iii) Single line diagrams.

iv) Sequence & Protection Interlock Schemes.

v) Alarm and trip values.

vi) Performance Curves.

vii) General layout plan and layout of main plant building and auxiliary buildings

viii) Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03.02 **PROJECT COMPLETION REPORT**

The Contractor shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **DRAWINGS**

a) i) All the FGD plant layouts shall be made in computerised 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check.

ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per **Annexure-VI** of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC.

Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site.

The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.

iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per **Annexure-VI** of Part-C.

iv) Contractor shall prepare the model of all the facilities located in FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE (including all

facilities), and any other facility in an integrated & intelligent 3D software solution using rule-based, data centric 3D Design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model. Contractor shall make a presentation on 3D model every 3 months from LOA to enable NTPC to review the progress of engineering. After the completion of engineering the corresponding complete 3D review model shall be handed over to the employer for its reference.

Contractor shall provide 3D model (which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc), which is extracted from intelligent 3D model, for employer's review as & when desired by employer. However, all piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings.

b) All documents/text information shall be in latest version of MS Office / MS Excel / PDF FORMAT as applicable.

c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.

The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".

Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature.

f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.

g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.

h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer piror to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.

Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

j) As Built Drawings

After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as per **Annexure VI**.

k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

l) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.

n) The Contractor shall submit drawings in line with the suggestive MDL covered in Part-B, Section-VI of Technical Specification and which shall be duly integrated with approved PERT network.

8.04.00 **ENGINEERING INFORMATION SUBMISSION SCHEDULE**

Prior to the award of Contract, a Detailed Engineering Information Submission Scheduler/Master Drawing List duly integrated with approved PERT network shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorized into the following parts.

i) Information that shall be submitted for the approval to the Employer before proceeding further, and

ii) Information that would be submitted for Employer's information only.

The Master Drawing List (MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL.

The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

8.05.00 **ENGINEERING PROGRESS AND EXCEPTION REPORT**

8.05.01 The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including

a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission

b) Drawings which were not submitted as per agreed schedule.

8.05.02 The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.

8.06.00 Engineering Co-ordination Procedure

8.06.01 The following principal coordinators will be identified by respective organizations at time of award of contract:

NTPC Engineering Coordinator (NTPC EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

Contractor's/ Vendor's Engineering Coordinator (VENDOR EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

8.06.02 All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.

8.06.03 Contractor's/Vendor's Drawing Submission and Approval Procedure:

a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings".

b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.

c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance.

d) Employer and contractor shall follow their own numbering systems for the drawings. However, Employer shall intimate the contractor, NTPC drawing number on receipt of the first submission of each drawing. Vendor, thereafter, shall indicate NTPC's drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number.

e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission.

g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories :

CATEGORY- I: Approved

CATEGORY- II Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments.

CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted.

CATEGORY -IV For information and records.

h) Contractor shall resubmit the drawings approved under Category II, III & IVR within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number

enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**

i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.

l) These comments will be taken care by the contractor while submitting the revised drawing.

The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.

9.00.00 **TECHNICAL CO-ORDINATION MEETING**

9.01.00 The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

9.02.00 The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing .The

	comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.
9.02.01	The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.
9.02.02	Should any drawing remain unapproved for more than six (6) weeks after it's first submission ,this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.
9.03.0	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.
10.00.00	**DESIGN IMPROVEMENTS** The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.
11.00.00	**EQUIPMENT BASES** A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.
12.00.00	**PROTECTIVE GUARDS** Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

13.00.00 **LUBRICANTS, SERVO FLUIDS AND CHEMICALS**

13.01.00 I. All the first fills of consumables and one years topping requirement of consumables such as greases, oil, lubricants, servo fluids / control fluids, gases and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be supplied by the Contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.

Bidder shall supply a quantity not less than 10 % of the full charge or one (1) year topping requirement mentioned above (whichever is higher) of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) which is expected to be utilized during the first year of operation. The additional quantity shall be supplied in separate container.

13.02.00 As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible.

Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.

14.00.00 **LUBRICATION**

14.01.00 Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.

15.00.00 **MATERIAL OF CONSTRUCTION**

15.01.00 All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.

16.00.00 **RATING PLATES, NAME PLATES & LABELS**

16.01.00 Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.

16.02.00 Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.

16.03.00 Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear side.

16.04.00 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.

16.05.00 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support or hanger.

16.06.00 Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.

16.07.00 Safety and relief valves shall be provided with the following:

a) Manufacturer's identification.

b) Nominal inlet and outlet sizes in mm.

c) Set pressure in Kg/cm^2 (abs).

d) Blowdown and accumulation as percentage of set pressure.

e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.

16.08.00 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

16.09.00 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

17.00.00 **TOOLS AND TACKLES**

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. In case these tools and tackles are used by the Contractor during erection, commissioning or initial operation the same shall be refurbished repaired/replaced as required to the satisfaction of the Employer before handing over to the Employer. All the tools and tackles shall be of reputed make acceptable to the Employer.

18.00.00 **WELDING**

18.01.00 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.

19.00.00 **COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES**

19.01.00 All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.

20.00.00 **PROTECTION AND PRESERVATIVE SHOP COATING**

20.01.00 **PROTECTION**

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for

painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.

20.02.00 **PRESERVATIVE SHOP COATING**

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification.

Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.

20.03.00 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

20.04.00 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.

20.05.00 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.

20.06.00 Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.

21.00.00 **QUALITY ASSURANCE PROGRAMME**

21.01.00 To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A

quality assurance programme of the contractor shall generally cover the following:

a) His organisation structure for the management and implementation of the proposed quality assurance programme

b) Quality System Manual

c) Design Control System

d) Documentation Control System

e) Qualification data for Bidder's key Personnel.

f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

h) Control of non-conforming items and system for corrective actions.

i) Inspection and test procedure both for manufacture and field activities.

j) Control of calibration and testing of measuring testing equipments.

k) System for Quality Audits.

l) System for indication and appraisal of inspection status.

m) System for authorising release of manufactured product to the Employer.

n) System for handling storage and delivery.

o) System for maintenance of records, and

p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as **Annexure-I** and **Annexure-II** respectively.

22.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

22.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of

	inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.
22.02.00	Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I)
22.03.00	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II).
22.04.00	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.
22.05.00	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at **Annexure-V.** The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
22.06.00	The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP)

	and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.
22.07.00	No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).
22.08.00	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details
22.09.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
22.10.00	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
22.11.00	Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorized representative.
22.12.00	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping system ASME B31.1 or other relevant code as applicable shall be followed. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding
22.13.00	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
22.14.00	No welding shall be carried out on cast iron components for repair.

22.15.00	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
22.16.00	All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination) or equivalent. NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be ultrasonically tested.
22.17.00	The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished preferably on enclosed format at **Annexure-IV.** Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.
22.18.00	For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. With in three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the

	monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.
22.19.00	Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
22.20.00	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
22.21.00	Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
22.22.00	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
22.23.00	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
22.24.00	**Environmental Stress Screening** Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having substantial electronics components (as determined by employer) like Electronic transmitter, CCTV components, PA systems etc. shall be necessarily furnished for any sub vendors proposed for vendor assessment and approval for this contract. For other approved sub vendors of above mentioned systems, contractor shall furnish the test procedure for eliminating infant mortile components in case, if it is asked for by the employer before these items are offered for inspection / dispatched to site.
22.25.00	The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.

22.26.00	**Software Reliability / Quality Certification** Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β-version and offered software is also free from all known bugs as on date of approval of systems documents by NTPC as a part of quality documentation review and approval process during detail engineering.
23.00.00	**QUALITY ASSURANCE DOCUMENTS**
23.01.00	The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓)mark.
23.01.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.
23.02.00	Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. (e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.

(h.) Certificate of Conformance (COC) wherever applicable.

(i.) MDCC

23.03.00 Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

23.04.00 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

(c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.

23.05.00 **TRANSMISSION OF QA DOCUMENTATION**

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.

24.00.00 **PROJECT MANAGER'S SUPERVISION**

24.01.00 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.

24.02.00 The work shall be performed under the supervision of the Project Manager.

The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

(a.) Interpretation of all the terms and conditions of these documents and specifications

(b.) Review and interpretation of all the Contractor's drawing, engineering data, etc

(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract

(d.) Inspect, accept or reject any equipment, material and work under the contract

(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates

(f.) Review and suggest modifications and improvement in completion schedules from time to time, and

(g.) Supervise Quality Assurance Programme implementation at all stages of the works.

25.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

25.01.00 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

25.02.00 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain

30.00.00 **NOISE LEVEL**

The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA . However for Ball Mills the noise levels as per following shall also be acceptable:

a) Ball Mill < 90 dBA

31.00.00 **PACKAGING AND TRANSPORTATION**

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.

32.00.00 **ELECTRICAL EQUIPMENTS/ENCLOSURES**

32.01.00 All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.

33.00.00 **INSTRUMENTATION AND CONTROL**

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

33.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

1 Temperature - Degree centigrade (deg C)

	2. Pressure	-	Kilograms per square centimetre (Kg/cm^2). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
	3. Draught	-	Millimetres of water column (mm wc).
	4. Vacuum	-	Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).
	5. Flow (Gas)	-	Tonnes/ hour
	6. Flow (Steam)	-	Tonnes/ hour
	7. Flow (Liquid)	-	Tonnes / hour
	8. Flow base	-	760 mm Hg. 0 deg.C
	9. Density	-	Grams per cubic centimeter.

33.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.

33.03.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.

34.00.00 **ELECTRICAL NOISE CONTROL**

The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).

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

S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	--
	ii) Approved Copies (Direct to Site)	4 sets	2
7	Project Completion Report (Directly to site)	6 sets	2
8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	--
9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	--
10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc i) For review/comment	1	--
	ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2
11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals i) For review/comment	1 set	--
	ii) Approved copies (Direct to Site)	4 sets	2
12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2
13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2

5.00.00 **AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT**

The unit auxiliary power consumption shall be calculated using the following relationship.

$P_a = (P_{a1} + P_{a2} + \ldots\ldots\ldots + P_{an})/n$

$P_{an} = P_{un} + T_{Ln}$

P_a = Guaranteed Auxiliary Power Consumption

P_{an} = Auxiliary Power Consumption for unit # n

(Where "n" is the unit number e.g. 1, 2, ……)

P_{un} = Power consumed by the auxiliaries of the unit under test

T_{Ln} = Losses of the transformers supplied by bidder based on works test reports

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:

xxi. Air Conditioning System (*)

Total Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of FGD Control Room Building divided by total nos. of units in respective project

xxii Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)

((*) Above guaranteed power consumption values shall be at 20 deg C for centrifugal fans of AHUs and at 30 deg C for centrifugal fans of UAF units and at an elevation of RL (referring to GLP of respective projects) for both AHUs and UAF centrifugal fans.)

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	**FANS**
2.01.00	20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.
2.02.00	DPT of fan shafts shall be carried out after machining.
2.03.00	UT of fan shafts (diameter equal to or above 50mm) shall be carried out.
2.04.00	Rotating components of all fans shall be dynamically balanced to ISO-1940 Gr. 6.3
2.05.00	All Fans shall be subjected to run test for 4 hrs. or till temperature stabilization is reached. Vibration, Noise level, Temp. rise and current drawn shall be measured during the run test.
2.06.00	One fan of each type and size will be performance tested as per corresponding BIS /AMCA for Air flow, Static Pressure, Speed, Efficiency, Power Consumption, Noise, Vibration and Temp. Rise.
3.00.00	**AIR HANDLING UNIT**
3.01.00	For Fans refer tests as mentioned at 2.00.00
3.02.00	One per type of assembled AHU (AHU casing and fan assembly) shall be subjected to free run test. Noise, Vibration and Temp. Rise of bearing shall be measured during run test.
3.03.00	All cooling coil shall be pneumatically tested and no leakage shall be permitted.
4.00.00	**CENTRIFUGAL PUMP**
4.01.00	UT on pump shaft (dia equal to or above 40 mm) and MPI/DPT on pump shaft and impeller after machining shall be carried out.
4.02.00	All rotating components of the pumps shall be dynamically balanced to ISO-1940 Gr. 6.3
4.03.00	A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the shut off pressure on the head characteristics curve or twice the rated pressure whichever is higher, for a minimum duration of 30 minutes.
4.04.00	Standard Running Test

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

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

एनटीपीसी NTPC	ITEM (material, class, grade, rating, range, size etc.)	STANDARD QUALITY PLAN	QP NO.: 0000-999-QOM – S - 091	REVIEWED BY:	APPROVED BY
	CENTRIFUGAL FAN (DIDW/SISW) (Capacity AS per Manufacturer Approval Range)	CONFORMING TO CODE: IS 4894	Rev. No. 00 Date 30.03.2017	H S MAURYA	K K OJHA
			Page 1 Of 2	RAJEEV GARG	
			VALID UPTO : 19.03.2020	K J RAO	

SN	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS		FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N						M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.		9.	D*	10			11.
1	MATERIAL OF CONSTRUCTION & BOUGHT OUT ITEMS														
1.1	MS Sheet/ Plates for Casing & Impeller	Visual & Dimension	Major	Visual & measure	100%		----------No defect---------- Approved drawing / data sheet				-	P	-	-	
		Chemical & Physical	Major	Physical & Chemical test	1 Sample/ heat or lot		Relevant Material standard as per approved drawing/ data sheet			Material test report	√	P	V	V	
1.2	Bar Stock for Shaft & Shaft Sleeve	Visual & Dimension	Major	Visual & measure	100%		----------No defect---------- Approved drawing / data sheet				-	P	-	-	
		Chemical & Physical	Major	Physical & Chemical test	1 Sample/ heat or lot		Relevant Material standard as per approved drawing/ data sheet			Material test report	√	P	V	V	
		UT OF SHAFT	Major	NDT	100%		ASTM A 388	Refer Note-1		UT Report	√	P	V	V	If shaft Dia is 50mm dia. & above
1.3	Bearing	Make, Number, Visual	Major	Visual	100%		Approved Drawing/Datasheet	Approved Drawing/Datasheet		COC	√	P	V	V	
1.4	Pulley	Visual	-do-	Visual	100%		Mfr Standard	No defect		COC		P	V	-	
2.0	IN PROCESS INSPECTION														
2.1	Casing / Impeller fabrication	DPT of butt welding as applicable	Major	DP Test	20%		ASME SEC-V, Article-V I / ASTM E 165	No Relevant Indication		DP test report	√	P	V	V	
2.2	Shaft	DPT of machined surface	Major	DP Test	100%		ASME SEC-V, Article -VI / ASTM E 165	No Relevant Indication		DP test report	√	P	V	V	
2.3	Impeller dynamic balancing	Residual Un-balance	Critical	Dynamic Balancing test	100%		ISO-1940, GR-6.3	ISO-1940, GR-6.3		Dynamic Balancing report	√	P	V	V	
3.0	Final Inspection														
3.1	Assembly of Fans	Overall Dimension	Major	Measurement	100 %	Random one fan per size	Approved Drawing	Approved Drawing		Inspection report	√	P	W	W	

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

NOTE: # NTPC INSPECTION ENGINEER TO CHECK, APPROVAL DATE / REVISION NO. OF REFERENCE DOCUMENTS AT THE TIME OF INSPECTION.

एनटीपीसी NTPC	ITEM (material, class, grade, rating, range, size etc.)	STANDARD QUALITY PLAN	QP NO.: 0000-999-QOM – S - 091	REVIEWED BY:	APPROVED BY
	CENTRIFUGAL FAN (DIDW/SISW) (Capacity AS per Manufacturer Approval Range)	CONFORMING TO CODE: IS 4894	Rev. No. 00 Date 30.03.2017	H S MAURYA RAJEEV GARG K J RAO	K K OJHA
			Page 2 Of 2		
			VALID UPTO : 19.03.2020		

SN	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M	QUANTUM OF CHECK C / N	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	AGENCY M	AGENCY C	AGENCY N	REMARKS
1.	2.	3.	4.	5.	6.		7.	8.	9.		10			11.
3.2	Run test of fan for Four hours or till stabilization or temperature rise whichever is earlier.	RPM, Current, Vibration, Noise and Temperature rise	Critical	Measure ment	100%	Random one fan per size per visit from offered lot	Approved TDS/ GA Drg	Approved TDS/ GA Drg / Vibration - Satisfactory level as per VDI-2056. Gr. - T. Temperature rise - 40-degree C. maximum above ambient temp. Noise- 85 Db at 1 mtr	Run test Report	√	P	W	W	
3.3	Performance test with Job Motor / shop Motor (as applicable in technical specification) (refer note 3 for motor)	Flow, RPM, Static Pressure, Power consumption , Static Efficiency, Noise level, Vibration & Temperature rise	Critical	Measure ment	One of each type and size (To be randomly selected from complete lot)		IS 13368 / 4894/ AMCA 210 for DIDW and	Approved TDS/ GAD / Vibration - Satisfactory level as per VDI-2056.Gr T Temperature rise - 40-degree C. maximum above ambient temp. Noise- 85 Db at 1 mtr	Performance test report	√	P	W	W	Noise and vibrations are for reference purpose at shop, Guaranteed value to be shown at site
3.4	Spray Galvanizing / Painting	Visual, DFT	Major	Visual, Measure ment	100%	100%	NTPC painting Schedule	NTPC painting Schedule	Painting / Spray Galv report	√	P	V	V	
3.5	Review of QA Documentation	Compliances	Major	Review	100%	100%	As per AQP	As per AQP	Test reports		P	V	V	

NOTE-

1. When back wall echo set to 100% of FSH in sound area of material, defects echo shall not exceed 20% of FSH and or back wall echo shall not fall to less than 80% of FSH.
2. Material of construction shall be as per approved drawing /data sheet/ technical specification. If MOC is not mentioned in approved drawing /data sheet/ technical specification, then MOC as per manufacturer standard will be applicable.
3. i) For Motors less than 30 KW: Acceptance of Motor less than 30 KW is based on COC of the Manufacturer and the Main Contractor confirming as follows: "It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between center of stud & gland plate and tested in accordance with approved drawing /data sheets".

ii) For Motors 30 KW and less than 50 KW : Acceptance of Motor rating from 30 KW & up to 50 KW is based on NTPC review of Routine Test inspection report as per IS: 325/applicable standards duly witnessed by main contractor along with COC of the Manufacturer and the Main Contractor confirming as follows: "It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between center of stud & gland plate, space heater and tested in accordance with approved drawing /data sheets".

iii) For Motors 50 KW & above: AS PER NTPC APPROVED QUALITY PLAN (To be submitted separately for NTPC review & approval).

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

NOTE: # NTPC INSPECTION ENGINEER TO CHECK, APPROVAL DATE / REVISION NO. OF REFERENCE DOCUMENTS AT THE TIME OF INSPECTION.

	MANUFACTURING QUALITY PLAN	PROJECT : 2 X 250 MW NSPCL BHILAI TPP- FGD
UNITARY AIR FILTRATION / Air washer unit	BHEL doc. No.PE-V0-468-(571-13000-A)-A005	MAIN- CONTRACTOR/SUPPLIER :BHARAT HEAVY ELECTRICAL LIMITED
	Rev. No. R0	PACKAGE : HVAC FOR FGD SYSTEM
	NTPC Doc. No 9993-109-QVM-B-317, R0	
	SHEET NO.	

S.No.	COMPONENT/ OPERATION	CHARACTERISTICS	CATEGORY OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD		INSPECTIO			REMARKS
					M	C / N					M	C	N	
(1)	(2)	(3)	(4)	(5)	(6)		(7)	(8)	(9)	D*	(10)			(11)
1.0	**RAW MATERIAL & BOUGHT OUT CONTROL**													
1.1	M.S sheets, Plates, Flats, Angles ,Sections & GI sheet	Visual & Chemical, Mechanical	Major	Visual, Measurement and Chemical Test	1 Sample / heat	1 Sample / heat	Appr. GA drg./ Appr. Data sheet	Appr. drg./ Appr. Data sheet	Manufacturer's Test certificate	√	P	V	–	Manufacturer's Test certificate to be provided
1.2	Pipes for header and spray set	Mechanical , Dimension	Critical	Manufacturer test certificate verification	1 Sample / heat	1 Sample / heat	IS 3589 / IS 1239	IS 3589 / IS 1239 (Heavy grade)	Manufacturer test certificate	√	P	V	–	
1.3	AIR FILTERS (HDPE/Nylon)	Visual, dimensional	Minor	TC VERIFICATION	1 / LOT	1 / LOT	Appr. GA drg./ Appr. Data sheet	Appr. drg./ Appr. Data sheet	Inspection report	√	P	V	–	
1.4	Mist eleminator (PVC)	Visual, dimensional	Minor	TC VERIFICATION	1 / LOT	1 / LOT	Appr. GA drg./ Appr. Data sheet	Appr. drg./ Appr. Data sheet	Inspection report	√	P	V	–	
1.5	Spray nozzle	Visual,dimensional, material	Minor	Visual	Random	Random	Avpl. Mfg. drg.	No Defect/AVPL drg.	Inspection report	—	P	V	—	
2.0	**IN PROCESS INSPECTION**													
2.1	Tank marking, cutting. Casing and piping fabrication	Visual, dimensional	Major	Visual & measurement	100%	10%	Appr. GA drg.	Appr. GA drg.	Internal insp. Report	—	P	V	—	
2.2	Welding / Weldament check	DPT of weld	Major	NDT	20%	20%	ASTM 165	No relevant Indication	Inspection report	√	P	V	–	
3.0	**IN ASSEMBLY SECTION**													
3.1	Over all dimension	Visual & Dimensions	Major	Measurement	Random	Random One per size	Approved drg	Approved drg	Inspection report	√	P	W	_	
3.2	Tank, Internal & casing	Visual, final dimensions	Major	Visual & Dimensions	100%	100%	Approved drg	Approved drg	Inspection report	√	P	W	_	
4.0	**FINAL INSPECTION**													
4.1	Water fill test (Leak test)	Visual	Critical	Visual	100%	One of each type / size	Water fill for 30 minutes	No Leakage	Inspection report	√	P	W	–	
4.2	Assembly *	Visual & measurement	Major	Visual & measurement	One of each type / size	One of each type / size	Approved GA drg	Approved GA Drawing	Assembly / Inspection report	√	P	W	–	*1 no. unit to be assembled at shop and inspected for visual/measurement.
4.3	Painting	Visual	Minor	Visual	100%	100%	As per specs.	As per specs.	Inspection report	√	P	W	–	

NOTE : * Assembly of air washer consists of sump, distribution plate, spray chamber piping, nozzle, mist eliminator, supply air fan, enclosure with door and window.
External items like Louvers, filters, pipe & pump shall be installed at actual site

	DOC.NO.	REV.NO.	CAT.
NTPC			

AVPL Manufacturer / Sub supplier	BHEL Main Contractor	LEGEND : RECORDS IDENTIFIED WITH 'tick' SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOC. M: MANUFACTURER / SUB SUPPLIER, C : MAIN SUPPLIER / CONTRACTOR, N: NTPC P : PERFORM, W : WITNESS, V: VERIFICATION AS APPROPRIATE CHP, NTPC SHALL IDENTIFY COLUMN 'N' AS 'W'	FOR NTPC USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL
SIGNATURE						

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SECTION: I

SUB-SECTION: C 2C

FOR PAINTING DETAILS REFER SECTION C2-A

SECTION: I

SUB-SECTION: C-3

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

CONTENTS

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.

TECHNICAL SPECIFICATION

FOR

AC & VENTILATION SYSTEM

(ELECTRICAL PORTION)

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.

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 & VENTILATION SYSTEM
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: KORBA STPP STAGE- I, II & 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 & VENTILATION SYSTEM
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: KORBA STPP STAGE- I, II & 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.

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

3.00.00 **TYPE**

3.01.00 **AC Motors:**

a) Squirrel cage induction motor suitable for direct-on-line starting.

b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be **Premium Efficiency class-IE3**, conforming to IS 12615, or IEC:60034-30. HT motors shall have minimum design efficiency of 95 %. However, tolerance on this efficiency value shall be applicable as per IEC 60034

c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

d) Motor operating through variable frequency drives shall be suitable for inverter duty with VPI insulation. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.

e) Motors operating through variable frequency drives shall also meet the requirements mentioned in subsection for VFD.

3.02.00 DC Motors Shunt wound.

4.00.00 **RATING**

(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.

(b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

5.00.00 **TEMPERATURE RISE**

Air cooled motors

70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.

Water cooled

80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.

6.00.00 **OPERATIONAL REQUIREMENTS**

6.01.00 **Starting Time**

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

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

suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

7.11.00 The spacing between gland plate & centre of bottom terminal stud shall be as per Table-I.

7.12.00 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

7.13.00 The motors shall be suitable for bus transfer schemes provided on the 11kV, 6.6 KV, 3.3 kV /415V systems without any injurious effect on its life.

7.14.00 For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

7.15.00 The size and number of cables (for HT motors) to be intimated to the successful Contactor during detailed engineering and the Contactor shall provide terminal box suitable for the same.

8.00.00 The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance):

(a) From 50KW & upto 110KW : 11.0

(b) From 110 KW & upto 200 KW : 9.0

(c) Above 200 KW & upto 1000KW : 10.0

(d) From 1001KW & upto 4000KW : 9.0

(e) Above 4000KW : 6 to 6.5

10.00.00 TYPE TEST

10.01.00 **HT MOTORS**

10.01.01 The Contactor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Contactor shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's engineer.

10.01.02 The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the Contactor. The Contactor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different

10.01.06 **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of HT motor

(a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

(b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.

(c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15

(d) Surge-withstand test on inter-turn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

10.02.00 **LT Motors**

10.02.01 LT Motors supplied shall be of type tested design. During detailed engineering, the Contactor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last *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.

10.02.02 However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.

10.02.03 **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of LT motor of above 100 KW only

1. Measurement of resistance of windings of stator and wound rotor.

2. No load test at rated voltage to determine input current power and speed

3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)

4. Full load test to determine efficiency power factor and slip

5. Temperature rise test

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

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

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

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

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

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

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		
		○ 110 kW and above (Breaker Controlled)	:	50 KA for 0.25 sec.
		○ Below 110 kW (Contactor Controlled)	:	50 KA protected by HRC fuse
	f)	LV System grounding	:	Solidly
5.0	Winding & Insulation		:	Class F with temp rise limited to class B
6.0	Minimum voltage for starting (As percentage of rated voltage)		:	85% for motor ratings below 110kW 80% for motor ratings from 110kW to 200kW.
7.0	Power cables data		:	Shall be given during detailed engg.
8.0	Earth Conductor Size & Material		:	Shall be given during detailed engg.
9.0	Space heater supply (for motors >=30kw)		:	240 V, 1ϕ, 50 Hz
10.0	Rating up to which Single phase motor		:	Acceptable below 0.2 kW
11.0	Locked rotor current			
	a)	Limit as percentage of FLC	:	As per IS 12615
12.0	Makes		: BHEL/ Customer approval (Package owner to take care)	
13.0	Paint shade		:	Blue (RAL 5012) – Corrosion proof
14.0	Degree Of protection for motor/ terminal box		:	Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-

i) Indoor motors - IP 54
ii) Outdoor motors - IP 55
iii) Cable box-indoor area - IP 54
iv) Cable Box-Outdoor area - IP 55

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

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

1.0 INTENT OF SPECIFIATION

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

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

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

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 mimimum 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: 4691and 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.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

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 /General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/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/IEC60034IIEC 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										
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										

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.

Each cable vault should have at least two doors.

Exit signs shall be provided near doors for personnel escape in case of emergency

2.01.06 **Boiler Area**

Cable trays in boiler & ESP area shall be supported from the boiler and ESP structures. The same shall be coordinated with SG/ESP contractor.

Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in boiler/ESP area.

2.01.07 Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries.

2.01.08 **OffSite Area**

For feeder in bidder's scope for offsite areas, overhead cable tray arrangement shall be followed. However cable trenches/slit may also be acceptable, for some areas, if found to be required during detailed engineering.
Cable trenches provided shall be separated from fuel oil area to avoid oil accumulation.

2.01.09 The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.

2.01.10 Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable.

2.01.11 Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to:

- Meet all safety requirements
- Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc

3.00.00 EQUIPMENT DESCRIPTION

3.01.00 **Cable trays, Fittings & Accessories**

3.01.01 Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.

3.01.02 Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter.

3.01.03 Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.

3.01.04 Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip

galvanised as per Clause No. 3.13.00 of this chapter. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.

3.01.05 The tolerance for cable tray and accessories shall be as per IS 2102 (Part-1).
Tolerance Class: - Coarse

3.02.00 **Support System for Cable Trays**

3.02.01 Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings.

3.02.02 Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder

a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fitings and accessories shall be prefabricated factory galvanised.

c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied

d. All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation.

e. The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below:

The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079.

f. Cantilever arms of 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.

g. Support system shall be able to withstand

- weight of the cable trays
- weight of the cables (75 Kg/Metre run of each cable tray)
- Concentrated load of 75 Kg between every support span.
- Factor of safety of minimum 1.5 shall be considered.

3.02.03 The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid.

3.02.04 Four legged structure shall be provided wherever there is change in elevation and change in direction

3.02.05 FOR COAL HANDLING PLANT/**FGD PLANT AREA** THE FOLLOWING SHALL ALSO BE APPLICABLE**:**

a) All overhead cable routes shall be along the route of the conveyor gallery on separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0M above the grade level except for rail/road crossings where it shall be at 8.0M above grade level. Tap offs from the overhead cable trestle can be through shallow trenches with prior approval of the Employer. Directly buried cable, if essential, shall not have concentration of more than 4 cables on one route.

b) Cable trenches shall be provided only in Switchgear/MCC rooms.

c) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc.

d) Cables for PCS and BSS shall be routed along the conveyors through GI conduits.

3.03.00 **Pipes, Fittings & Accessories**

3.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

3.03.02 GI Pipes shall be of medium duty as per IS: 1239

3.03.03 Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

3.03.04 Hume pipes shall be NP3 type as per IS 458.

3.03.05 TERNE Coated Flexible Steel Conduits shall be water proof and rust proof made of heat resistant lead coated steel. Conduit diameter shall be uniform throughout its length. Internal surface of the conduit shall be free from burrs and sharp edges. Conduits shall be complete with necessary accessories for proper termination of the conduit with junction boxes and lighting fixtures

3.03.06 HDPE pipes and conduits shall be PE-80, PN-10 type as per IS 4984/IS 8008 part-I.

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

3.05.03	1.1 KV grade Straight Through Joint shall be of proven design.
3.06.00	**Cable glands**
3.06.01	Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.
3.07.00	**Cable lugs/ferrules**
3.07.01	Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to IS/DIN standards.
3.08.00	**Trefoil clamps**
3.08.01	Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current.
3.09.00	**Cable Clamps & Ties**
3.09.01	The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.
3.10.00	**Receptacles**
3.10.01	Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break,AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable 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.
3.11.00	**Cable Drum Lifting Jack**
	The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack

	nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for NTPC use. Contractor has to make arrangements for his own jacks for cable reeling/unreeling under his scope of installation.
3.12.00	**Galvanising**
3.12.01	Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.
3.12.02	The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified
3.13.00	**Welding**
3.13.01	The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595
4.00.00	**INSTALLATION**
4.01.00	**Cable tray and Support System Installation**
4.01.01	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.
4.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with tray loadings/drawings.
4.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.
4.01.04	The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage.
4.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.
4.01.06	In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the

installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

4.02.00 **Conduits/Pipes/Ducts Installation**

4.02.01 The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.

4.02.02 GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.

4.02.03 Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material

4.02.04 Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	**Spacing**
Upto 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm and above	3.0 M

4.02.05 For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.

4.03.00 **Junction Boxes Installation**

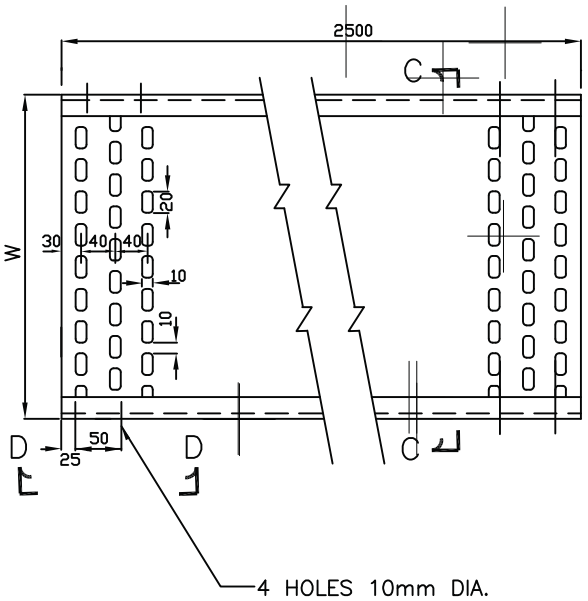
4.03.01 Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

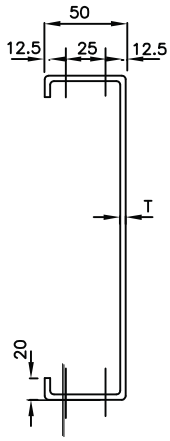
4.04.00 **Cable Installation**

4.04.01 Cable installation shall be carried out as per IS:1255 and other applicable standards.

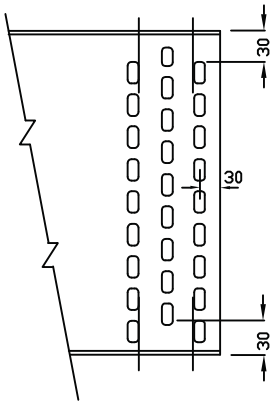
4.04.02 For Cable unloading, pulling etc following guidelines shall be followed in general:

a) Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid

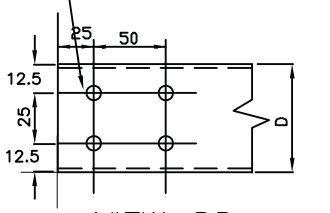




SECTION–CC
(100/50 TRAYS)



ARRANGEMENT OF
PERFORATIONS

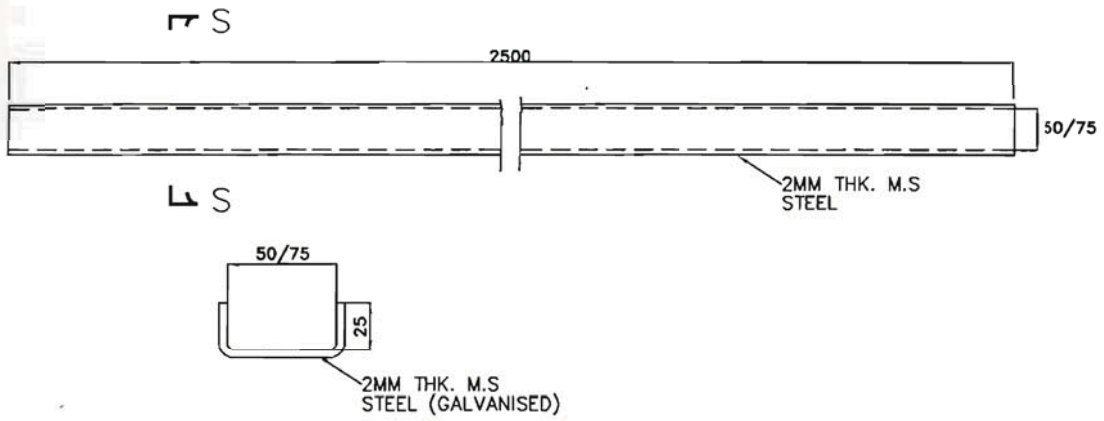


VIEW–DD
(100,50W TRAYS)

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

PERFORATED TYPE TRAY

भेल BHEL	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	DWG. NO.



SECTION S–S

CABLE TROUGHS

~~SEE GENERAL NOTES IN SHEET 11.~~

TYPICAL DETAILS OF
CABLE TRAY AND ACCESSORIES

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

~~SH 10 OF 11~~ ~~REV 00~~

SECTION: I

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

INDEX

C&I SPECIFIC TECHNICAL REQUIREMENT
FOR DCS BASED
HVAC SYSTEM

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.

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.

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

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

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).

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.

55.0 Double root valve shall be provided for all pressure tapings where the design pressure exceeds 40kg/cm2.

56.0 All the instruments PG/DPG/DPT/PT etc. (as applicable) having contact with corrosive media shall be provided with chemical/diaphragm seal.

57.0 Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic. Intimation to attained FAT shall be informed in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.

58.0 Bidder's presence is required for minimum 09 Man days (in three visits, excluding travel time) at site in which each visit shall be of minimum 03 Man days during commissioning of DCS for assistance related to process correctness. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.

59.0 Bidder's representative (process/ C&I owner) shall be present at BHEL-PEM Office for minimum 03 man-days, for preparation of Control scheme and operation and control philosophy of AC and ventilation system. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope

60.0 Number of pairs to be selected for Screen/ Control cable

(a) F-Type: 2P/4P/8P/12P(Size : 0.5 mm2)

(b) G-Type: 2P/4P/8P/12P(Size : 0.5 mm2)

(c) Core Cable: 3CX2.5sqmm2/ 5CX2.5sqmm2/ 12CX1.5sqmm2

61.0 Bidder to provide mandatory spares as per mandatory spares list. Attached elsewhere in the specification.

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.

GENERAL TECHNICAL REQUIREMENTS (HVAC SYSTEM)

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0 The quantity of instruments for auxiliary system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

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

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

1.00.00	**MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)**
1.01.00	Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval.
1.02.00	Every panel-mounted instrument requiring power supply shall be provided with easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
1.03.00	All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Contractor shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering.
1.04.00	The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.
1.05.00	All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor). For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications. For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum.
1.06.00	For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.
1.07.00	The instruments, for which technical specification is not attached, shall be supplied as per the standard and proven practice of the contractor. The same shall be established by the contractor during detailed engineering by providing detailed explanation/concepts, if required by the employer, of such implementation along with standard documentation.

16.00.00 **FIELD INSTRUMENTS BASED ON FIELDBUS**

The following instruments shall be connected to DDCMIS through fieldbus i.e. FOUNDATION Fieldbus/PROFIBUS PA protocol complying to IEC 61158 directly from transmitter.

16.01.00 **Electronic Transmitter for Pressure, Differential Pressure and DP based Flow / Level measurements.**

S No.	Features	Essential/Minimum Requirements
1.	Type of Transmitter	FOUNDATION Fieldbus/PROFIBUS PA based output

	2	Accuracy	± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc. +0.065% of calibrated range (minimum) for calibrated range greater than 250 kg/cm2. ± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc.
	3.	Stability	0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer. 0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer. 0.15% of calibrated range for 5 years for DPT with static pressure greater than 250 kg/cm2.
	4	Turn down	50:1 for greater than or equal to span of 400mmwcl. 20:1 for span below 400mmwcl. 10:1 for span greater than 250 kg/cm2
		(Above mentioned (2,3,4) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only).	
	5	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating
	6.	Electrical connection	½" NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible
	7.	Process connection	½" NPT (F)
	8.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.
		Overpressure	150% of max operating pressure
	9	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & gauge pressure transmitters, -3-valve for DP and 5 valve manifold for level/flow applications. -The valve manifold shall be non-integral type. -For hazardous area, enclosure as described in NEC article 5.

10.	Mounting	2 inch pipe mounting with Enclosure/Rack/Canopy.
11.	Diagnostics & display	Self-Indicating feature and digital display on transmitter

Notes

- For primary air/ secondary air/flue gas/ furnace pressure applications, DP type transmitters shall be provided for pressure measurement below 2000 mmwc.
- LVDT type is not acceptable.
- Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

16.02.00 Temperature Transmitter

16.02.01 Single Input /Dual Input Temperature transmitter

Temperature transmitter shall be provided which shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself. Transmitters shall be capable of withstanding ambient temperature up to 85 deg C.

Following specifications are applicable for dual input/single input temperature transmitter.

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.

7.	Mounting	2 inch pipe mounting with Canopy.
8.	Accessories	As required by service and operating condition.
9.	Composite Accuracy	(Refer note 2)
		RTD =<0.25% of 0-250 deg C span
		T/C-K type =<0.2% of 0-600 deg C span
		CJC accuracy (for thermocouples) shall be =< 1 deg C

Notes:

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

3.02.00 **Resistance Temperature Detector (RTD)**

Sr. No.	Features		Essential/Minimum Requirements
1	Type of RTD.	:	Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
2	No. of element	:	Duplex
3	Housing/Head	:	IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well
4	Insulation and sheathing of RTD	:	Mineral (magnesium oxide) insulation and SS316 sheath,
5	Calibration and accuracy	:	As per As per IEC-751/ DIN-43760 Class-A for RTD
6	Accessories	:	Thermo well and associated fittings
7	Standard	:	IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.

NOTES :

1) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.

2) The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

3.03.00 **Metal Temperature Thermocouples**

Measuring Medium	Metal Temperature
Material of Thermocouple.	Chromel Alumel Type K
Type of Thermocouple	Duplex with ungrounded separate hot junctions
Insulation	Mineral Insulation (Magnesium Oxide).

	Thermocouple wire gauge	16 AWG
	Protective sheath	SS 321
	Protective sheath dia	8 mm OD
	Calibration & accuracy	As per IEC-584/ ANSI-MC-96.1 (special limits of error) for T/C
	Mounting accessories	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310. Adjustable gland fitting for connection at the junction box end as per manufacturer's standard.
	Cold end sealing	SS pot seal with colour coded PTFE Insulated flexible tails. Sealing compound- Epoxy resin. Length of PTFE insulated flying leads shall be minimum 750 mm.
	Minimum bending radius	30 mm
	Length of T/C	On as required basis considering location of measurement point and the JB/TTJB location.

Notes :

1) The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.

3.04.00 **Thermo well** (for all process temp. elements)

(a) Shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3, 1974)

(b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.

(c) For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if required based on the specified boiler design parameters).

(d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.

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

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.

5.00.00 **PROCESS ACTUATED SWITCHES**

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

Power Supply (wherever required)	As per Contractor's Standard practice.

Notes :-

1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications.

3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

6.00.00 **SOLENOID VALVES**

Solenoid valves shall fulfill the following requirements: -

a) Type 2/3/4 way SS 316/ forged brass (depending on the application subject to Employer's approval during detailed engg.)

b) Power supply 24V DC.

c) Plug in connector connection.

d) Insulation : Class "H"

7.00.00 **Limit switches**

e) Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of Fire alarm Control System subject to a minimum of 60V, 6VA rating. Protection class shall be IP-55.

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.

VFD

1.00.00 **GENERAL**

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

2.00.00 **CODES AND STANDARDS**

HT breaker	IEC:60056
DC reactor	IEC 60289
Transformers	IS:2026, IEC: 60076 IEC 61378
Bushing	IS: 2099, IEC 60137
Adjustable Speed Electrical Power Drive Systems	IEC 61800
Semiconductor converters–General requirements	IEC 60146
IEEE Recommended practices and requirements for harmonic control in electrical power systems	IEEE 519
Degrees of protection provided by enclosures (IP Code)	IEC 60529
Electrostatic immunity test	IEC1000-4-2
Fast transient immunity test	IEC1000-4-4

Surge immunity test	IEC1000-4-5
High-voltage switchgear and controlgear; Pt.102: Alternating current disconnectors and earthing switches	IEC 62271-102
High-voltage switchgear and controlgear; Pt.200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 KV	IS/IEC: 62271-200
AC electricity meters	IS: 722
Metal oxide surge arrestor without gap for AC system	IEC: 60099-4
Terminal blocks for copper conductors	IEC: 60947-7-1
Dry transformer	IS: 11171
Motor	IEC 60034-18-41 &42, IEC60034 / NEMA 30 & 31,
Contactor/Switches/Fuses etc.	IEC:60947, IS: 13947
Harmonics & EM compatibility	IEEE:519/IEC: 61000
VFD	IEC: 60034/ IEC: 61800

Equipment complying with other internationally accepted standards will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision amendments and revision in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

3.00.00 **OPERATING CONDITIONS**

3.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and also relative humidity of 95% at 40 deg. Celsius shall be considered.

3.02.00 All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

3.03.00 The auxiliary AC voltage supply arrangement shall have 11/6.6/3.3kV and 415V systems (as applicable). It shall be designed to limit voltage variations as given below under worst operating condition:

1. 11kV/ 3.3 kV/ 6.6 KV : +/- 6%
2. 415V : +/- 10%

Note: The Voltage level mentioned above is the Nominal Voltage available at the input of the VFD System from the MCC/ Switchgear/transformer, based on the system requirement/Availability.

The voltage level for the VFD output to be fed to motor shall be as follows:-

1. Upto 400 kW : 415V/690V, Low Voltage, Three Phase AC
2. Above 400kW and upto 700 KW : 690V, Low Voltage, Three Phase AC
3. Above 700KW : Medium Voltage

From here onwards in the specifications all the VFD Systems consisting of either 415 V or 690 V may be termed as LV VFD while the higher rated VFD System shall be termed as MV VFD. If nothing is mentioned than the Clause is applicable for both the LV and the MV VFD until deliberated otherwise.

4.00.00 **SYSTEM DESCRIPTION**

Type of drive	3-Phase Diode / Thyristor / Multi Stage IGBT / IGCT / SGCT/ IEGT
Type of Cooling of VFD	Naturally air cooled/forced air cooled/Liquid cooled
Converter Type	Full wave diode rectifier/active front end type
Inverter Type	Thyristor/IGBT/IGCT/SGCT/IEGT

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

	d. Any other as specified in data-sheet
6.04.00	VFDs shall comply with the latest edition of IEEE 519 & IEC 61000 for both individual as well as total harmonic voltage and current distortion limits. The Voltage and Current limits shall be applicable at the Point of Common Coupling (PCC), which shall be the MCC/ Switchgear/ from which the VFD system is fed.
6.05.00	The above compliance shall be verified by the field measurements of harmonics at the PCC with and without VFDs operation.
6.06.00	VFD shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short circuit. Any damage resulting from such a short circuit or internal fault shall be limited to the component concerned.
6.07.00	The system shall be suitable to maintain speed variation within range 10-110% or as per the requirement of driven equipment with speed set accuracy of +1% of rated maximum speed and steady state regulation of +0.5% of rated speed as per system requirement.
6.08.00	The VFD System shall maintain a power factor of 0.95 (minimum) (for LV VFD system) and 0.9 (minimum) (for MV VFD system) in the entire operating range.
6.09.00	Maximum allowable audible noise from the VFD system will be 85 dB (A) at a distance of one meter under rated loaded with all cooling fan operating conditions.
6.10.00	All the circuit components shall be suitably protected against over voltages, surges, lightning etc.
6.11.00	The panels shall be designed to provide easy access to hardware, to facilitate replacement of cards in case of any failure.
6.12.00	All the VFDs for particular application shall be of same design so as to ensure 100 % interchangeability of components.
6.13.00	For each programmed warning and fault protection function, the VFD shall display a message in complete English words or Standard English abbreviations. At least 30 time tagged fault messages shall be stored in the drive's fault history.
6.14.00	The VFD cubicles shall be placed in air conditioned environment. However if VFDs of less than 100 kW are designed to operate in non-air condition environment the same shall also be acceptable.
6.15.00	The 3-Phase Thyristor/IGCT/SGCT/ multistage IGBT/IEGT based VFD system shall have minimum number of components to ensure very high reliability. The input side converter shall have 3-Phase Diode/Thyristor bridge configuration modular type and inverter shall be of 3-Phase Thyristor/IGCT/SGCT/multi stage IGBT/IEGT type, using Pulse Width Modulation or better technique for generating near sine wave output to motor.
6.16.00	Fiber optic cable connection shall be provided preferably to ensure high network reliability.

7.00.00	**VFD COMPATIBILITY WITH THE MOTOR**
7.01.00	MV VFD output current waveform, as measured at the motor, shall be inherently sinusoidal at nominal loads, with a total harmonic current and voltage distortion within acceptable/standard limits. VFD with transformers on output side are not acceptable.
7.02.00	The system design shall not have any inherent output harmonic resonance in the operating speed range.
7.03.00	VFD shall provide stable operation of motor from high-voltage dv/dt stress, regardless of cable length to motor. The vendor shall clearly state the limitations in the motor cable distance in his proposal. However, due to system requirements & constraints if the cable length becomes critical, filters/ chokes etc. shall be provided by the VFD manufacturers as an integral part of the VFD to mitigate the reflected wave effect of harmonics.
8.00.00	**BYPASS ARRANGEMENT TO BE PROVIED BY BIDDER IF REQUIRED DURING DETAIL ENGINEERING**
8.01.00	The VFD System shall have an optional feature to run the motor under bypass arrangement for operation of Motor with VFD bypassed. During starting (under rated conditions) the motor will be switched on in VFD Mode to limit the starting current and after gaining speed, the load would be switched over to bypass mode.
8.02.00	Comprehensive motor protection scheme for protection and control for operation VFD during bypass mode shall be finalized during detailed engineering.
9.00.00	**STANDBY VFD ARRANGEMENT (OPTIONAL, IF SPECIFIED)**
9.01.00	A Common standby arrangement with auto/manual switchover shall be provided in case of failure of any VFD in a group of drives. Complete protection, interlocks & control required shall be provided in the changeover module.
10.00.00	**EFFICIENCY**
10.01.00	Efficiency (Drive only) shall be minimum 98% for both MV VFD and LV VFD. Overall efficiency shall be minimum 96.5% for LV VFD and minimum 94 % for MV VFD at rated load and speed. Overall Efficiency evaluation shall include input transformer, harmonic filters and power factor correction (if applicable), VFD converters, cooling fans and output filter, as applicable in the system. Auxiliary controls, such as internal VFD control boards, cooling fans/pumps.
10.02.00	In absence of valid test report, a factory test shall be performed at the VFD manufacturer's facility verifying the efficiencies. Manufactures who are supplying Drive and transformer from different locations, efficiency test will be conducted separately for Drive and transformer.
11.00.00	**COOLING SYSTEM**
11.01.00	The VFD shall be designed to operate indoor under temperature range of 0 deg C to 50 deg C and relative humidity of 95 %(at 40 deg C).

11.02.00	VFD manufacturer to primarily offer Air cooled Design. However in case of large ratings, liquid cooled drives may be accepted subject to employer's approval. In case of liquid cooled system, there shall be no necessity of continuous water supply system (Closed Loop System).
11.03.00	In case of Air cooled design, the VFD Cooling system shall be such that it puts minimum heat load inside the room and preferably throw the hot air outside the room with ventilation ducts. The Cooling system shall be designed in such a way that the Air Conditioning & Ventilation Air requirements are kept to minimum. The VFD Manufacturer shall furnish the data regarding heat load, air flow requirements during the detailed engineering.
11.04.00	Air cooled VFDs shall be provided with cooling fans mounted integral to the VFD/ enclosure. The VFD shall include air-flow pressure switches and temperature detectors to monitor proper operation of the air cooling system. If the fan fails, the system must generate the alarm/trip for the fan failure.
12.00.00	**TRANSFORMER:**
12.01.00	Type: Outdoor Mineral oil filled ONAN type or Indoor natural air-cooled Dry type, Three phase unit, rectifier/converter duty type transformer.
12.02.00	All other components, technical parameters shall be as per applicable IEC/IS.
12.03.00	Enclosure for Dry Type Transformer (as applicable) Enclosure shall be of a tested quality sheet steel of minimum thickness 2 mm & shall also accommodate cable terminations. The housing door shall be interlocked such that it should be possible to open the door only when transformer is off. The enclosure shall be provided with lifting lugs and other hardware for floor mounting.
12.04.00	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.

13.00.00	**POWER CONVERTER:**
13.01.00	The static power converter shall consist of a line side converter for operation as a rectifier and a load side power converter for operation as a fully controller inverter. Power converter shall be fast switching, most efficient and low loss type.
13.02.00	The converter shall be coordinated with the transformers. The converter shall be able to withstand a three phase short circuit current until interrupted by normal breaker operation.
13.03.00	Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.
13.04.00	All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.
13.05.00	The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the whole speed range. If the parallel connection of semiconductor is applied, the above current rating shall not be less than 140% of the above values.
13.06.00	All power diodes shall be of silicon type with minimum VBO rating at 2.5 times the rated operating voltage.
13.07.00	The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise nor reducing its service factor due to harmonic currents generated by the inverter operation. The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions / tools.
13.08.00	The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.
14.00.00	**OUTPUT FILTER (AS APPLICABLE):**
14.01.00	Output/ dv/dt filter shall be provided, if required. It shall be an integral part of the VFD system and included within the VFD enclosure. It shall inherently protect motor from high voltage dv/dt stress.
15.00.00	**DC LINK CAPACITOR (AS APPLICABLE):**
15.01.00	Capacitor shall be of self-healing film or electrolytic type having high life time. The capacitor shall be an integral part of VFD system. DC link Capacitors shall have

	discharge resistors which shall be capable of reducing the residual charges to zero just after the capacitor is disconnected from the supply source. The capacitor shall be suitable for high ripple currents.
16.00.00	AC/**DC Reactor (As applicable)** 1) Type: Dry type, air cored, self cooled, indoor type. Suitable for withstanding earth fault continuously. 2) Insulation: Thermal Class 155(F), temperature rise is limited to thermal class 130 (B). 3) Noise level shall not exceed value specified in NEMA TR-1.
17.00.00	**VFD PANEL REQUIREMENTS**
17.01.00	Enclosure frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material. In case dry type transformer is provided inside VFD panels, the enclosure and in its frame thickness shall be same as indicated in this para.
17.02.00	The cable entry shall be from the bottom of the panel and a removable bolted un-drilled gland plate.
17.03.00	All Panels shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 3X or better for MV VFD and IP: 4X or better for LV VFD as per IS/IEC 60947
17.04.00	Enclosures must be designed to avoid harmonic and inductive heating effects and to shield any outside equipment from interference, enclosing and shielding the complete to eliminate any radio frequency interference. The construction of the panel shall provide effective protection against electromagnetic emissions.
17.05.00	Each panel shall be provided with illuminating lamp, space heater with switch fuse and variable setting thermostat.
17.06.00	Proper ventilation using air filters and fans/pumps shall be provided in the panels to ensure that maximum temperature inside the cubicle is within permissible limits for reliable and continuous operation of the system.
18.00.00	**PAINTING** Paint shade shall be as follows a) VFD transformer reactor enclosure : RAL 5012 (Blue), legend in black letter b) Motors : RAL 5012 (Blue)

	c) VFD Panels : Front and rear panels in Grey (RAL9002). End panel sides in blue (RAL 5012)
19.00.00	**HT SWITCHGEAR**
19.01.00	The technical requirements of HT switchgear shall be as per chapter of HT switchgear in Part-B of Technical specifications.
20.00.00	**MOTORS**
20.01.00	VFD shall be used to drive three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application. These motors shall be provided with insulated bearing on at least one side.
20.02.00	Motors shall also meet the requirements mentioned in subsection for motors, 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	**LT & HT CABLES**
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21.01.00	Contractor's scope shall also include LT and HT cables suitable for VFD system and Motors.
22.00.00	**CONTROL AND PERFORMANCE REQUIREMENTS**
22.01.00	The VFD to provide an automatic current limiting feature to control motor currents during startup and provide a "soft start" torque profile for the motor load combination. Current and torque limit adjustments shall be provided to limit the maximum VFD output current and the maximum torque produced by the motor.
22.02.00	It shall be possible to vary the speed of the drive and control it in either Local or Remote mode. Local / Remote selection shall be done from VFD panel unless otherwise specified.

22.03.00	Provision shall be kept for exchange of information between different VFD control system parameters thru PLC/DDCMIS. Man machine interface for (MV) VFD shall have one flat TFT monitor with keyboard (password protected) in the VFD room and a color laser printer for system alarm and monitoring located in control room. Parameter Monitoring: -Input and output voltage of Drive - Input and output current of Drive - Motor speed - Input and output power frequency of Drive - Torque -Input and Output power of Drive system (covering transformer if applicable) - Output kWhr of Drive - Transformer (if applicable) temperature for alarm & trip. - Ambient temperature - Run/stop and local/remote status displayed
22.04.00	Drive shall be equipped with a front mounted operator console panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter. Control panel shall be operable with password for changing the protection setting, safety interlock etc.
22.05.00	Operator console/Main Control Card shall have facility / port to connect external hardware such as Lap-Top etc. Console shall have facility for upload and download of all parameter settings from one drive to another drive for start up and operation.
22.06.00	User-friendly licensed software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.
23.00.00	**PROTECTION FEATURES**
23.01.00	The system offered shall incorporate adequate protection features as per IEC 61800-4: 2002 Table-8, properly coordinated for the drive control and for motor including following: i) Converter transformer: short circuit, over current, earth fault & winding temperature high protection. ii) Incoming and outgoing line surge protection. iii) Under / over voltage protection iv) Phase loss, phase reversal, overload, negative phase sequence, locked rotor protection. v) Instantaneous Over current & Earth fault protection vi) Converter/Inverter module failure indication. vii) Over frequency/speed protection.

	viii) Ventilation failure indication & alarm. ix) Over temperature of VFD x) Bearing temperature protection. xi) System earth fault protection. xii) Speed reference loss protection.
23.02.00	Under VFD Bypass Mode (if applicable) all the electrical protections related to the Motor shall remain applicable.
24.00.00	**CONTROL FEATURES**
24.01.00	Following controls shall be provided as a part of the Operator Control Panel or through separate switches on the front panel door. i) Start / stop (in local/remote mode) ii) Speed control (Raise / lower) iii) Acknowledge/Accept/ Test Push Button for annunciation iv) Auto / Manual / Test Mode select v) Emergency stop vi) Trip-Remote Breaker
25.00.00	**DIAGNOSTIC FEATURES**
25.01.00	The VFD shall include a microprocessor/PLC based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.
25.02.00	Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available. It shall be possible to retrieve the record of events prior to tripping of the system or de-energization. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care of by the manufacturer for this purpose.
26.00.00	**SERVICEABILITY / MAINTAINABILITY**
26.01.00	Power Component Accessibility: All power components in the converter sections shall be designed for rack-out accessibility for ease of maintenance and to minimize repair downtime.

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

	out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the Contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.
28.03.00	**LIST OF TYPE TESTS TO BE CONDUCTED** The following type tests shall be conducted under this contract for MV VFD i) Overall efficiency determination of VFD system including transformer/ Harmonic filters etc at motor full load ii) Temperature rise test iii) Noise level iv) Harmonics of No load current.(Input/Output)
28.04.00	**LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED** The following type test reports shall be submitted for VFD Panels' **1) VFD panels (For LV VFD)** i. Rated Current/ Output ii. Temperature rise test iii. Noise level test iv. Power Loss Determination Test v. Power factor measurement. vi. Degree of Protection Test vii. EMC Test viii. The Fast transient SWC tests as per ANSI / IEEE C37.901-2002 / IEC 60255-22-04-2008 / IEC 61800 **2) VFD panels (For MV VFD)** i. Rated Current/ Output

ii. Current Sharing

iii. Voltage Division

iv. Power Loss Determination Test

v. Power factor measurement.

vi. Degree of Protection Test

vii. The Fast transient SWC tests as per ANSI / IEEE C37.901-2002 / IEC 60255-22-04-2008 / IEC 61800

3) AC/DC Reactor

i. Lightning impulse test(If applicable)

ii. Heat run test

iii. Short time current test(If applicable)

iv. Noise level test

4) Transformers (In case of non integrated type)

i. As per requirements mentioned in subsection for Transformer chapter in technical specifications.

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

	overall form and aesthetics of the desk. It shall have concealed cable & wire way management system. Telephone sets shall be mounted on the control desk. Sliding keyboard trays shall be provided on the CD. The exact profile of the desk, dimension and the radius of curvature shall be finalised during detailed engineering stage.
2.02.02	All operator monitors & mice shall be mounted on this CD.
2.02.03	The cabling / wiring between OWS & CPU's, power supply cables etc. shall be aesthetically routed and concealed from view.
2.03.00	**Internal Panel/Desk Items** Equipment and devices mounted within the panels/desk shall be mounted on suitable racks/brackets and shall be arranged for convenient access for adjustment and maintenance work.

1.0 SCOPE

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

2.0 CODES AND STANDARDS

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

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

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

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

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

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

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

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)
1.6 mm for doors and Not less than 2.0 mm for others

Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

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

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

3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm2 size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.

3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm2 to 2.5mm2 external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.

3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.

3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm2 size.

3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte

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

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

3.2 Hazardous Area Panel Requirement

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

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

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

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

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

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

3.3 Control & Monitoring devices

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

3.3.2 Alarm Annunciator System

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

3.3.3 Relays

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

3.3.4 Timers

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

3.3.5 Control / Selector Switches

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

3.3.6 Push Buttons / Indicating Lights

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

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

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

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

3.3.7 Ammeters

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

3.3.8 Miniature Circuit Breaker (MCB)

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

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

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

4.0 TESTING AND INSPECTION

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

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

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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

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

5.2. Mandatory Spares

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

5.3. Recommended Spares

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

6.0 DRAWINGS AND DOCUMENTS

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

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

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

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

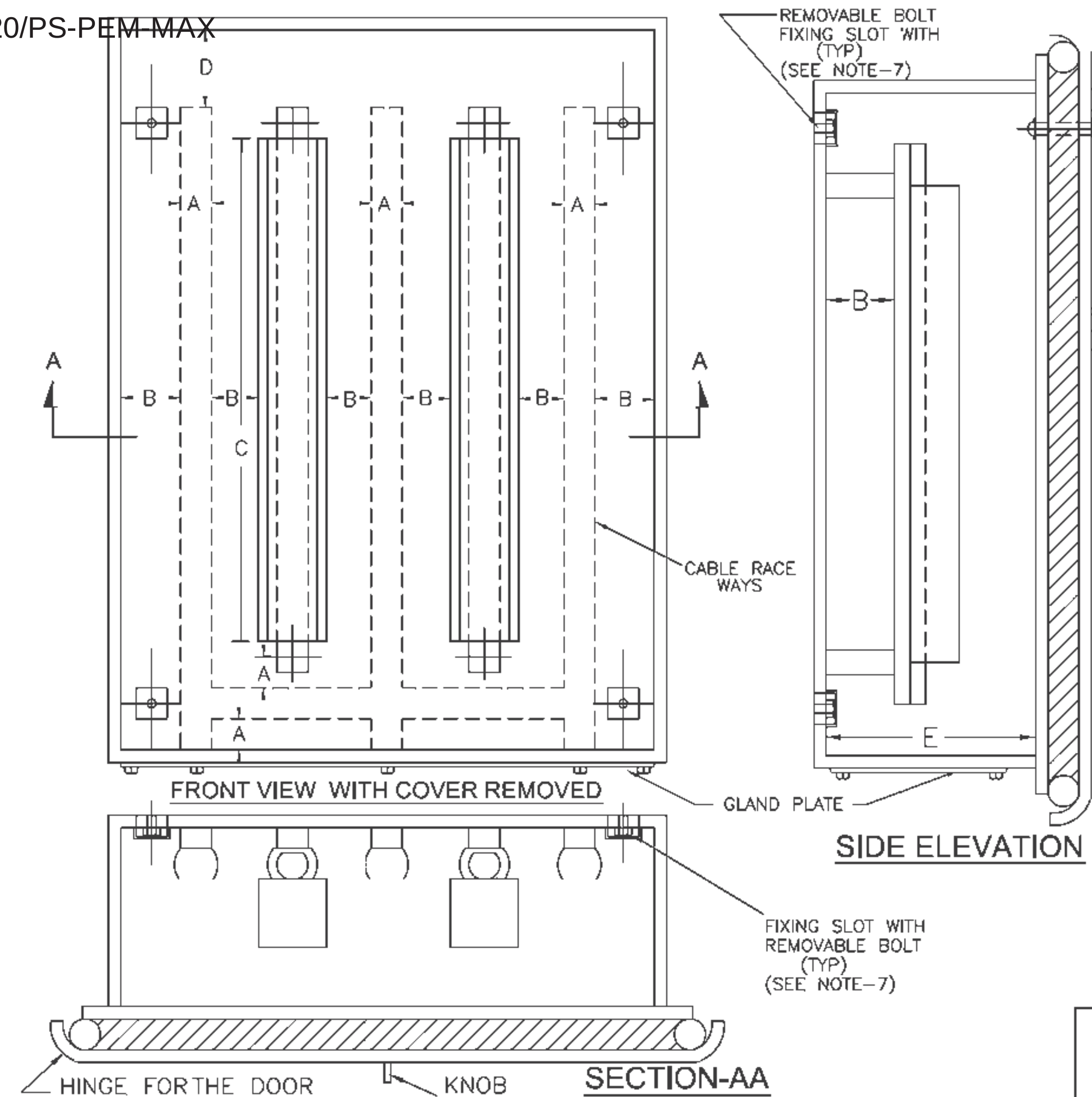
7.0 MARKING AND PACKING

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

8.0 APPLICABLE DATA SHEET FORMS

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

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



A – 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 POLYEUTHERENE COATING. ALSO REFER SUB SECTION INST CABLE, PART-B SECTION-VI FOR DETAILES.
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 ENGG. 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.

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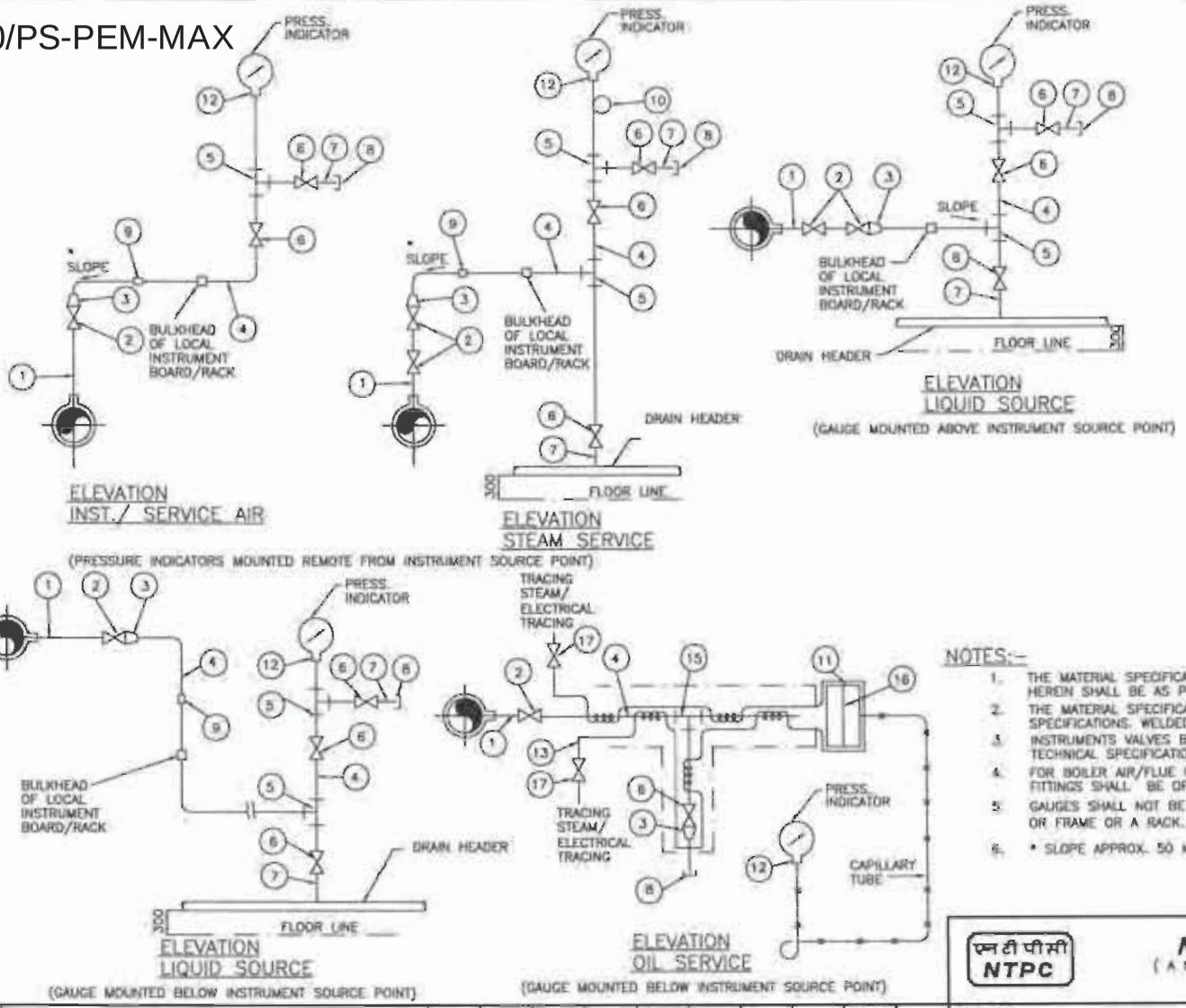
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
D	GENERALLY REVISED		JM	KS							21.08.12
C	GENERALLY REVISED		JM	KS							04.08.06
B	GENERALLY REVISED	S.K.	A.R	PS							
A	FIRST ISSUE	S.K.	A.R	PS							04.05.05

CLEARED BY

PROJECT: TYPICAL THERMAL POWER PLANT

TITLE: G.A. OF JUNCTION BOX

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-017	D



LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2", 3/4", 1" NPS SCH 40/80/160/XXS/P91 (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" / 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.	6" SS SYPHON
11.	1/2" BLIND 300lbs RF 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.	DIAPHRAGM(WAFER 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 RATING OF FITTINGS AS LISTED SHALL BE AS PER SPECIFICATIONS. WELDED/THREADED FITTINGS SHALL CONFIRM TO ANSI-B.16-11.
3. INSTRUMENTS VALVES BODY STEM MATERIAL AND PRESSURE CLASS SHALL BE AS PER TECHNICAL SPECIFICATIONS.
4. FOR BOILER AIR/FLUE 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 RACK.
6. * SLOPE APPROX. 50 MM / METRE.

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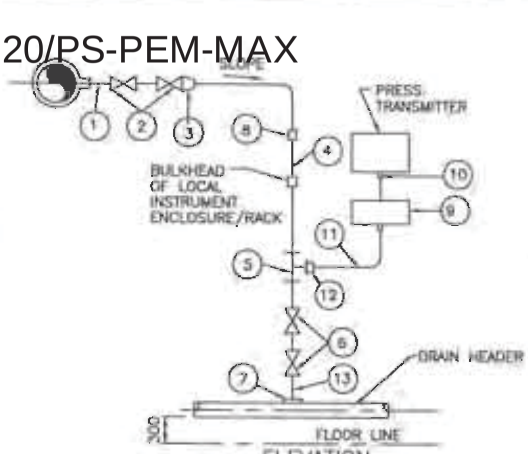
ENGINEERING DIVISION

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

PROJECT: TYPICAL THERMAL POWER PROJECT

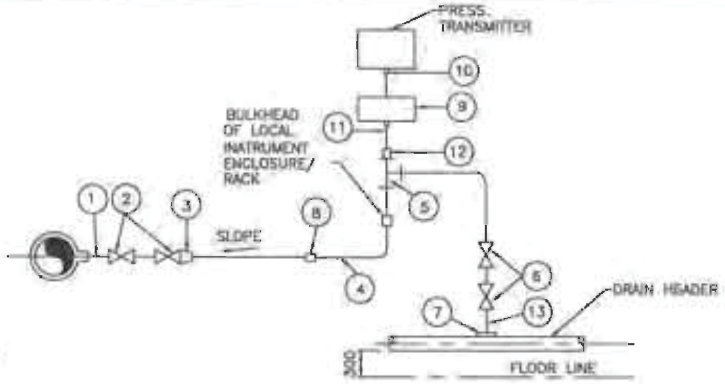
TITLE: INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-022	A



ELEVATION

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



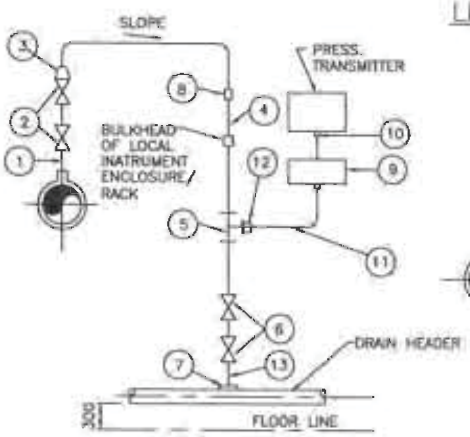
ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIQUID PRESSURE MEASUREMENT

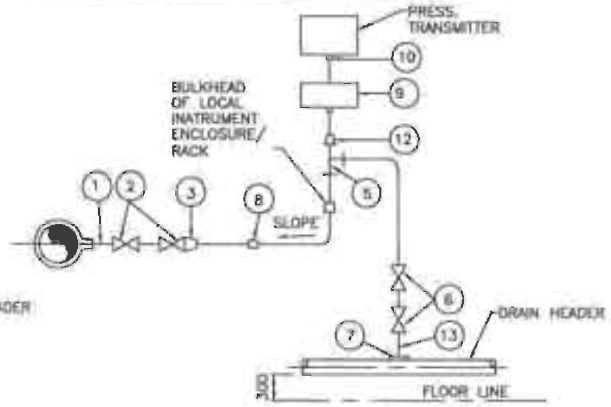
LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2" / 3/4" /1"NPS SCH. 80/160/XXS/P91 NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	3/4"/1" SW GLOBE VALVE.
3.	3/4"/1" TO 1/2" REDUCING INSERT
4.	1/2" NPS PIPE
5.	1/2" SW EQUAL TEE
6.	1/2"SW GLOBE VALVE
7.	1/2"NPS SCH. 80/160 SWx1/2"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 SWx1/2" NPT(M) CS/AS NIPPLE



ELEVATION

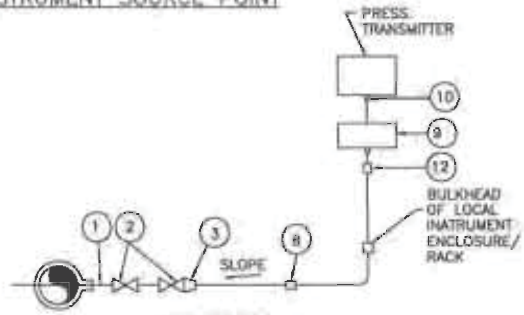
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

STEAM PRESSURE MEASUREMENT



ELEVATION

VACCUM 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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NTPC LIMITED
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ENGINEERING DIVISION

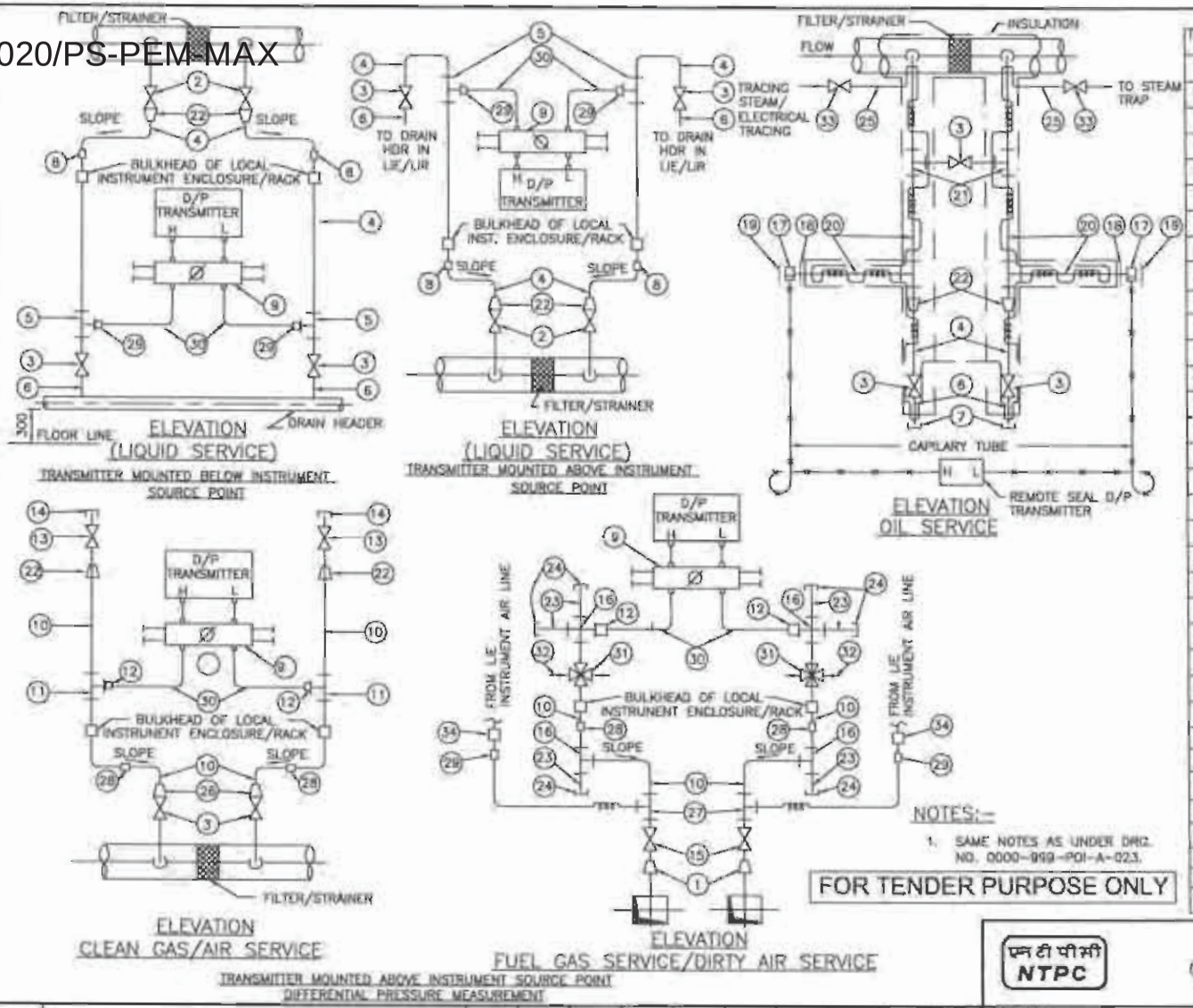
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS /DP TRANSMITTERS STEAM/LIQUID VACUUM)

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

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-025	A



NOTES:-

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

FOR TENDER PURPOSE ONLY

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 TEE.
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-026.
10.	3/4" SCH 80 CARBON/ALLOY STEEL PIPE.
11.	3/4"/1/2" SW EQUAL TEE.
12.	3/4"x1/2" 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.	WAFER ELEMENT FOR USE WITH 3"ANSI R.F. VALVE.
18.	3"BLIND 300lbs R.F. WELD NECK FLANGE DRILLED FOR 1" SCH. 40/80 PIPE.
19.	3" BLIND FLANGE.
20.	1"NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) CS PIPE.
21.	1" SW EQUAL TEE.
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 TEE.
28.	3/4" PIPE UNION
29.	1/2" CLAMP UNION (THREADED) SUITABLE FOR FLEXIBLE CONNECTION OF NYLON REINFORCED PVC TUBE.
30.	SS TUBE
31.	3/4" SW 4 WAY VALVE.
32.	QUICK DISCONNECT FITTINGS.
33.	1/4" SW ISOLATION VALVE 316SS.
34.	1/2" x 1/2" SS PIPE UNION.

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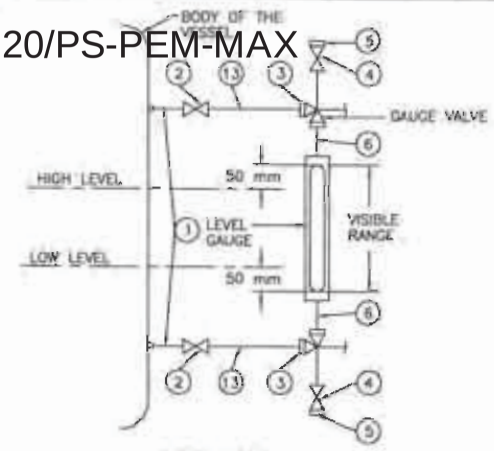
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM
DIFF. PRESS.MEASUREMENT (LIQUID, OIL, AIR/GAS SERVICE)

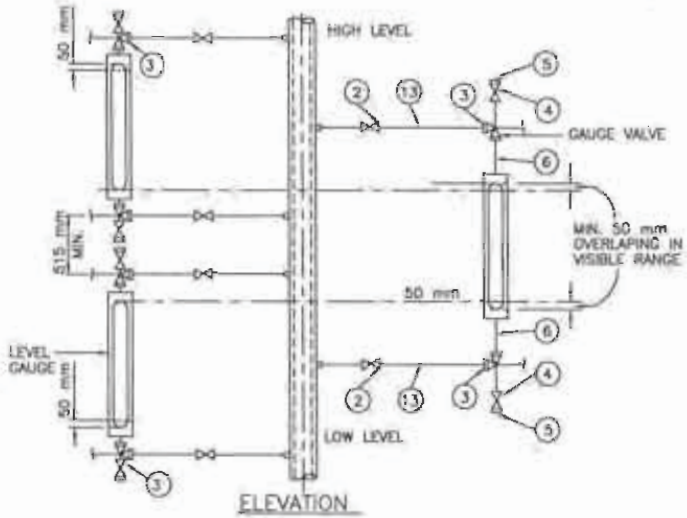
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE.							T.G.			21.08.12

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-030	A



ELEVATION

LOCAL LEVEL INDICATION USING GAUGE GLASS

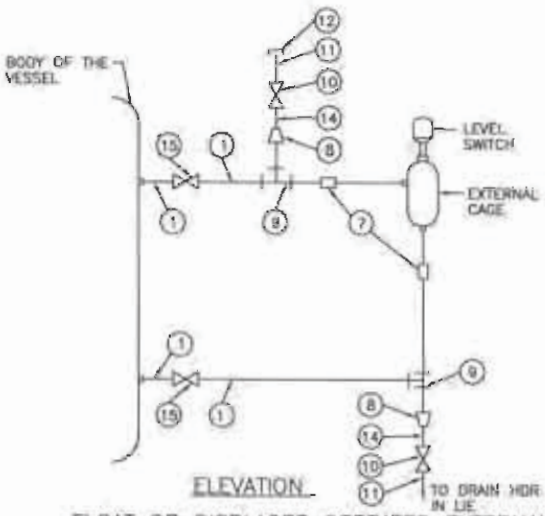


ELEVATION

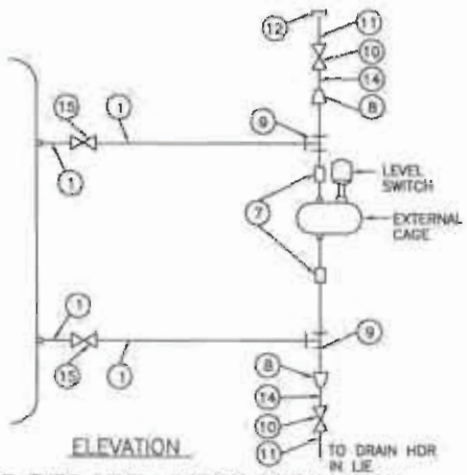
LOCAL LEVEL INDICATION USING MULTIPLE GAUGES FOR INCREASED RANGE NOT COVERED IN A SINGLE UNIT

LIST OF MATERIALS

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



ELEVATION



ELEVATION

FLOAT OR DISPLACER OPERATED EXTERNAL CAGE TYPE LEVEL SWITCH INSTALLATION

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 RELEVENT).

FOR TENDER PURPOSE ONLY

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N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INSTRUMENT INSTALLATION DIAGRAM (LEVEL GAUGE & SWITCHES)

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

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-031	A

PROCESS CONNECTION AND PIPING

1.00.00 **PROCESS CONNECTION PIPING**

1.01.00 The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-Section on as required basis for the connection of all instruments and control equipments of entire plant.

1.01.01 **IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS**

1.01.02 All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers. The size of impulse pipe shall be ½" for Steam & Water Application and ¾" for Air & Flue Gas applications. The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:

Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70
Valves (Material, Pr. Class, Size)	ASTM A182/ASTM A105 as per ASME 16.34
Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009
Installation Schemes	BS 6739-2009, ANSI/ISA 77.70

Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. Two root valves are to be used wherever pressure is more than 40 Kg/cm^2 or Temp>280 ^oC. The end connections of valves shall be of socket welded type. Typical installation scheme of DP Transmitter (inside LIE/LIR) mounted below instrument source point is indicated in Drg. No. 0000-999-POI-A-036. Same scheme with necessary changes shall be applied for other instruments.

1.01.03 The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below:

Manifold	Application/Measurement
2 Valve	Pressure measurements using pressure transmitters/pressure switches
3 Valve	Pressure measurements using differential pressure transmitter/ switches
5 Valve	Differential Pressure, Flow and Level Measurements

For Pr./D.P gauges, two-way globe/gate valve shall be provided on each impulse line to the instrument in Fluid/Air & Flue Gas applications respectively .

2.00.00 **AIR SUPPLY PIPING**

2.01.01 All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc.

2.02.00 Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of mill, dirty air and flue gas applications. Purging Scheme shall be as per Drg. No. 0000-999-POI-A-036.

2.03.00 The Contractor shall also provide SS Tubing and associated fittings (screwed type) of suitable sizes for all pneumatic equipments/actuators (including supply air, signal air and output to actuators) conforming to ANSI 31.1 and 31.3 standard. All other air supply lines shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty

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

CLAUSE NO.	TECHNICAL REQUIREMENTS

The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of LIE and JB of LIE/LIR shall be IP-55.

The enclosures shall be constructed of 3 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key.

The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack.

Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided.

Contractor shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR.

5.01.00 ENCLOSURE / RACKS FOR DUAL I/P TEMPERATURE TRANSMITTERS

All Dual Input temperature transmitters for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant and (ii) Racks in case of covered areas. Integral JB shall be provided with each Enclosure and Rack.

The internal layout shall be such that the transmitters are accessible from both front and back side of the enclosure / rack for easy maintenance.

Enclosure/ Racks shall be of robust and rugged design. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of Enclosure and JB shall be IP-55.

Enclosure and Racks shall be free standing type.

Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein.

Contractor shall provide not more than five variants for Enclosure/ Rack with respect to max. no. transmitters mounted in each Enclosure/ Rack. However, the maximum number of Transmitters that can be grouped in one Enclosure/ Rack shall be decided during detail Engineering.

QUALITY ASSURANCE-INSTRUMENTS, LCP & TYPE TEST REQUIREMETS

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)									
TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable)(R)	Hydro Test(R)	Material Test certificate ®
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
3. Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter(IEC-60770)	Y	Y	Y	Y	Y	Y			
5. Temp. Switch	Y	Y	Y	Y	Y	Y			
6. Recorder(IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Y		Y			
9. Integrators	Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples (IEC – 754 / ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD(IEC-751)	Y	Y	Y	Y	Y	Y			
14. Thermowell	Y		Y				Y	Y	Y
R-Routine Test A- Acceptance Test Y – Test applicable									

: Note: **1) Detailed procedure of Environmental Stress Screening shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization**

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

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.

Process, Connection & piping FOR C&I SYSTEMS

TESTS / ITEMS	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	Paint Shade/thickness ®	Flattening, flaring, hydrotest, hardness check as per ASTM standard	Component Ratings ®	Wiring ®	Make, Model, Type, Rating®	IR & HV ®	Review of TC for instrument/devices (R)	Accessability of TBs/Devices ®	Illumination,grounding ®	Tubing ®	Leak/Hydro test(A)	Chemical/physical properties of material (A)	Proof pressure test,Dismantling & reassembly test,Hydrulic impulse and vibration test (R)	Tests as per standards & specification
Local Instrument enclosure	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Local instruments racks	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box	Y	Y	Y	Y *		Y		Y	Y								
Gauge Board	Y	Y	Y	Y		Y		Y		Y			Y	Y			
Impulse pipes and tubes	Y		Y		Y			Y							Y		
Socket weld fittings ANSI B-16.11	Y		Y					Y							Y		Y
Compression fittings	Y		Y					Y						Y	Y	Y	
Instrument valves & Valve manifolds	Y		Y					Y						Y	Y		
Copper tubings ASTM B75	Y							Y									Y

*-applicable for painted junction boxes.

Note: R-Routine Test A- Acceptance Test Y – Test applicable

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.

SUB VENDOR LIST

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

Sl No	Package Name	Supplier Name	Supplier Communication Address
1	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : 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 Jayaprakash, 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@ashcroftindia.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 Dorn 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 : mktg@indfos.com
9	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, 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 : anidel@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- 9892230623, 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 : gtilworks@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 : anidel@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, NACHARAM, 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@goainstruments.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 Kannan/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 : ramk@giconindia.com
35	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com
36	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.- MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
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 : priyanka.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@goainstruments.com,
40	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.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- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
42	TRANSMITTERS	V. AUTOMAT & INTRUMENTS (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
43	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, 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,Parsiwada, 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, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.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@miinet.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 : ankit.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@delbby.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.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave 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@sorinc.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@sorinc.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/ 27&37, 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@sumip.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. SITARAM/ 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. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
71	LEVEL SWITCH-CAPACITANCE TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
72	LEVEL SWITCH-CAPACITANCE TYPE	V. AUTOMAT & INTRUMENTS (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 Bhosari, 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-CONDUTIVITY 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-CONDUTIVITY 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-CONDUTIVITY 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-CONDUTIVITY TYPE	HI-TECH SYSTEMS & SERVICES LTD.	Mr. Vikash Agrawal/Mr. Tarun Debnath 119, PARK STREET , KOLKATA Phone- 033-22290045 Pincode : 700016 Email : sandeep@hitech.in
81	LEVEL SWITCH-CONDUTIVITY TYPE	RAMAN INSTRUMENTS PVT.LTD.	Mr. N R Shenoy/Mr G B Vijh 8, First Floor.Plot : 160A Bait-Ush-Sharaf, 29th Road,Bandra(W) MUMBAI Phone- 09892331381 Pincode : 400050 Email : ramanbpl@vsnl.com
82	LEVEL SWITCH-CONDUTIVITY TYPE	V. AUTOMAT & INTRUMENTS (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-CONDUTIVITY TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in

84	LEVEL SWITCH-CONDUTIVITY TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
85	LEVEL SWITCH-FLOAT TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
86	LEVEL SWITCH-FLOAT TYPE	V. AUTOMAT & INTRUMENTS (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,SELIMPUR 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/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 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 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
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 Kannan/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@sorinc.com, avdhesh@sherman-india.com,
95	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/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. SITARAM/ 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. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
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 Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com

101	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
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 : santosh@panamengineers.com,
105	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
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	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com

No e :- 1. The abo e S b-Vendo li i en a i e efe ence onl . Ho e e S b-Vendo Li i bjec o BHEL/End e a o al i ho an comme cial /deli e im lica ion. 2. Ne S b-Vendo if o o ed b Vendo d ing con ac age hall bjec o BHEL/end e a o al i ho comme cial/deli e im lica ion.

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

		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

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

		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
		FILTERATION 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

		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
		MAHARASTRA 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

		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

	CABLE CONVERTOR	SYSTEM POWER CONTROL
		JACKSON ENGINNEERS
		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.

LIST OF MAKES OF SUB-VENDOR ITEMS

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

		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	INSULTATION MATERIAL	BEARDSHEL
		K-FLEX
		PARAMONT
		ARMAFLEX

		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

		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

		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
		FILTERATION 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.

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4. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3, C-4 FOR ELECTRICAL AND C&I RELATED EQUIPMENT LIST OF MAKE.

SECTION-I
SUB SECTION -E

ANNEXURE-II

MANDATORY SPARE LIST

(REFER SUGGESTIVE PRICE FORMAT)

ANNEXURE-III

LIST OF TOOLS & TACKLES
REFER SUGGESTIVE PRICE FORMAT

SECTION-I

SUB-SECTION-E

ANNEXURE-IV

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE

(PLEASE REFER SECTION – I, SUB-SECTION C2B, GENERAL TECHNICAL REQUIREMENT)

SECTION-I

SUB-SECTION-D

ANNEXURE-V

PACKING PROCEDURE

PACKING REQUIREMENT

	COMMON GUIDELINES FOR PACKING
1	**GENERAL:**
1.1	The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit & storage. This packing shall be suitable for different handling operations and for the adverse conditions during transportation and during indoor / outdoor storage of materials.
1.2	All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.
1.3	The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement.
1.4	Each package shall be accompanied by a packing note quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.
2.	**TYPES OF PACKING:**
	The following 5 types of packing have been standardized for packing of General Components/ Assemblies.
a	**OP**' - Open Type.
b	**PP**' - Partially Packed.
c	**CP**' – Crate/Box Packing - Components/Equipment requiring physical protection.
d	'**CQ**' - Case Packing – Machined components-Small & Medium Components/ Assemblies/ Equipment which require corrosion & physical protection.
e	**'CR'** - Case Packing – Electrical/Electronic Components/ Assemblies, which require special packing viz. Water Proof, Shock Proof etc…
3.	**DESCRIPTION OF TYPES OF PACKING:**
	The various types of packing, as standardized above, are described below.
3.1	**'OP' - Open Type**
	In case, of components which are not affected by water & dust and do not require special protection, are generally not machined, shall be sent as open packages. However, these components may be sent in crates, wherever necessary.
3.2	**PP' - Partially Packed**
3.2.1	Components which need special protection at selected portions only shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces should be protected with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene
3.2.2	Film. All sharp corners and edges shall be protected by rubber mats to prevent damage to the polyethylene film.
3.3	**'CP' - Crate Packing**
	Assemblies/Components which need only physical protection from the point of view of handling shall be despatched duly packed in crates.
3.4	**'CQ' - Case Packing -** Machined Components/Assemblies/Equipment
3.4.1	Small and medium sized components/assemblies/equipment due to size/weight and to avoid handling and pilferage problems shall be packed in Case/Containers. Wherever required adequate quantity of silica gel or VCI Powder/Tablets, packed in thin muslin cloth cotton bags shall be suitably placed. Small machines/components of less weight shall be provided with suitable cushioning by Rubberised coir. The components inside the case shall be entirely covered with100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film, wherever required. This may be prescribed for electronic parts/critical machined components/surfaces.
3.4.2	For mechanical product like valves where motors are separately securely wrapped in polyethylene, the requirement of individual component wrapping shall be exempted.
3.5	**CR' - Case Packing** - Electrical & Electronic Components/Assemblies
	Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons. Adequate quantity of Silica gel packed in cotton bags of 100grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film before being packed in the cases. VCI Powder/Tablets can be used as an alternative to Silica Gel.

4	**PREPARATION OF PACKING CASES**
4.1	**DIMENSIONS:**
a)	Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25/20mm +2/-3 mm as per applicable drawings of the respective units/manufacturers.
b)	Width of all planks including the tongue shall be more than 125mm and after plaining it shall be minimum 100mm.
c)	Minimum number of planks shall be used for a shook.
d)	Horizontal, vertical, diagonal planks shall be given for binding (number of such planks depend on the dimension of panel.
e)	Width of binding planks shall be minimum 100mm.
f)	Distance between any 2 binding planks shall be less than 750mm.
g)	diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm
h)	Distance of the outer edges of these planks from the edge of case shall be less than 250mm.
i)	Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.
4.2	**HOOP IRON STRIPS**
	These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6+0.01mm. The material shall be free from rust. If sufficient nailing is done for bigger boxes, strapping need not be done.
4.3	**BRACKETS**
	These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of “L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.
4.4	**MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM**
	100GSM (Colourless) Multi Layered Cross Laminated Polythelene Film are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.
4.5	**RUBBERISED COIR:**
	The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.
5	**MULTI LAYER CROSS LAMINATED POLY FILM WHILE PACKING OF CUBICLES/CASING**
5.1	The inner surface of 4 sides of shook's shall be nailed with Multi-layer cross laminated poly film (as per 4.4) using blue nails wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.
5.2	The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film. This sheet shall project outside on 4 sides by at least 100mm and shall be nailed properly on sides. Joining of sheets should have overlap of minimum 20mm.
5.3	The cubicles shall be covered with Multi-layer cross laminated poly film.
6	**PACKING OF LOOSE ITEMS/SPARES**
6.1	Inner surfaces of all 6 sides shall be lined with Multi Layered Cross Laminated Polythelene Film (as per clause 5.4) using blue nails.
6.2	Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.
6.3	Internal packing: Items that go into the box shall be packed using 100GSM, (Colourless) Multi Layered Cross Laminated Polyethylene Film. Any space left between the job and the sides and the top of the box shall be filled with rubberized coir to get proper cushioning effect.
6.4	Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.
6.5	Silica gel held in cotton bags shall be kept at proper places in the box.
6.6	Packing slip kept in polyethylene bag shall be placed in the box.
6.7	Two numbers of hoop iron strips shall be strapped tightly on the case using clips.
6.8	Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.
6.9	Loose items to be kept inside the cubicle/casing
	- Other items which are given loose in addition to cubicle shall be packed in separate boxes.

7	**TYPICAL PATTERN OF WOODEN BOX**

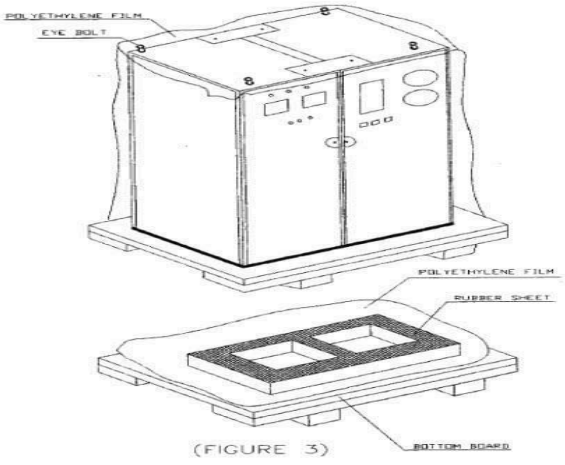


Figure 2

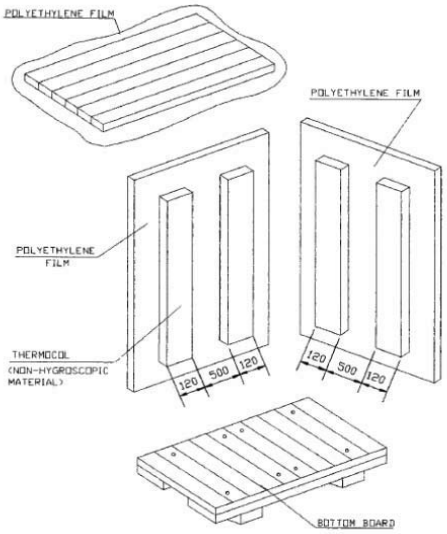
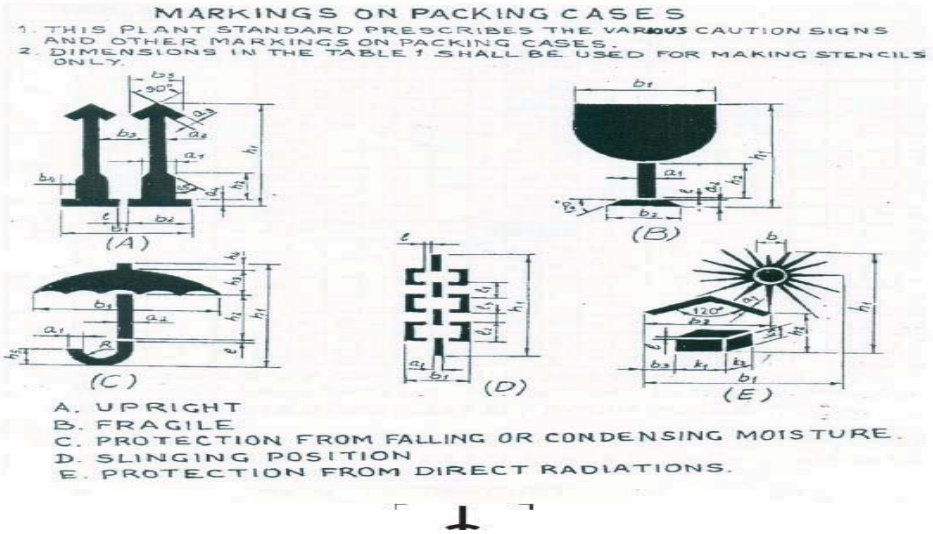


Figure 1

8	**SEALED PACKING:**
	Components sub-assemblies and assemblies sensitive to climatic conditions shall be packed seal tight. All the openings of the sensitive components, sub-assemblies and assemblies shall be blanketed to prevent the ingress of dust and moisture. The components sub-assemblies and assemblies are completely covered with 2 layers of polyethylene sheet. All sharp corners and

9	**MARKINGS/STENCILINGS**
9.1	**"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".**
9.2	Besides the caution signs the product information's shall be stencilled of letters with 13mm to 50mm height.
9.3	In case of consignment consists of more than one package, each package shall carry its package no as given in shipping list. All caution signs shall be stencilled in high quality full glossy out door finishing paint red in colour (AA56126). All other markings shall be carried out in black enamel.
9.4	Caution signs & other markings shall be stencilled on both the end shooks & the side shooks.
9.5	Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.
9.6	In case the size of package is small for using the stencils, then hand written letters/figures shall be allowed.



	BHEL – <unit> - <location> - <pin>				
CONSIGNEE					
MATERIAL					
CUSTOMER REF.			MO. NO.		
DESPATCH ADVICE NOTE NO			CASE NO		
DIMENSIONS(MM) L x B x H			NET WT –KGS	GROSS WT –KGS	
SPECIAL INSTRUCTIONS	HANDLE WITH CARE - KEEP DRY DO NOT DROP - DO NOT TILT				

Figure 4 – TYPICAL MARKING PLATE (225 X 170)

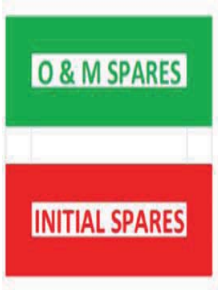


Figure 5

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites

10	STANDARD METHOD OF PACKING

Table 1 - Standard Method of Packing

S. No.	DESCRIPTION	CASE	CRATE	BUNDLE	BARE	DRUM
1	CHILLER/ CONDENSING UNIT	O				
2	PUMPS	O				
3	DUCTING			O		
4	AHU	O				
5	SUPPORTING STRUCTURALS				O	
6	FANS	O				
7	GASKETS	O	O			
8	FLANGES	O	O			
9	MOTORS, TRANSMFORMERS, VVVFD, LIMIT SWITCHES, ELECTRIC HOIST ASSEMBLY, RELAYS, FUSES, LIGHTING FIXTURES, PENDANT, ISOLATING SWITCH, RRC, TRANSMITTERS AND OTHER ELECTRICAL ACCESORIES	O				
10	CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL,		O			
11	OPERATIONAL SPARES , MAINTENANCE TOOLS AND TACKLES	O				
12	ALL OTHER LOOSE ITEMS	O				
	Note					
	Protective coating applied on machined surfaces should not be disturbed. The plastic covering should be put back carefully so that it prevents ingress of dust and moisture. Some packing may have vapour phase inhibitor (VPI) paper enclosed inside the packing cases. This should be restored to its original place as far as possible.					

SECTION II

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)'.

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

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.

PRE-BID CLARIFICATION SCHEDULE

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

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

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

NO DEVIATION CERTIFICATE

SL NO	VOULME / SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ 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
TECHNICAL DEVIATIONS										
COMMERCIAL DEVIATIONS										

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE			
NAME	**DESIGNATIONS**	**SIGN & DATE**	**COMPANY SEAL**

NOTES:

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.

Guaranteed Power Consumption						
NAME OF PROJECT:		MAUDA TPS - FGD (FGD SYSTEM PACKAGE)				
NAME OF PACKAGE:		HVAC FOR FGD SYSTEM				
TECHNICAL SPECIFICATION No:		PE-TS-444/466/468-571-013-A001				
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
1	VENTILATION SYSTEM					
1.1	UAF					
1.1.1	UAF FAN (110000 CMH, 65MMWC Static)	1	0		1	
					TOTAL (KW)	

Note:	Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as **31.1 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 139360/- (INR One Hundred Thirty-Nine Thousand Three Hundred Sixty 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 **139360/- (INR One Hundred Thirty-Nine Thousand Three Hundred Sixty only)** per KW shall be levied on vendor. 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				
Name	Designation	Signature	DATE	Company Seal

Guaranteed Power Consumption						
NAME OF PROJECT:		KORBA TPS - FGD (FGD SYSTEM PACKAGE)				
NAME OF PACKAGE:		HVAC FOR FGD SYSTEM				
TECHNICAL SPECIFICATION No:		PE-TS-444/466/468-571-013-A001				
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
1	VENTILATION SYSTEM					
1.1	UAF					
1.1.1	UAF FAN (120000 CMH, 65MMWC Static)	2	0		1	
					TOTAL (KW)	

Note:

Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as **68 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.

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

Name	**Designation**	**Signature**	**DATE**	**Company Seal**

Guaranteed Power Consumption						
NAME OF PROJECT:		BHILAI TPS - FGD (FGD SYSTEM PACKAGE)				
NAME OF PACKAGE:		HVAC FOR FGD SYSTEM				
TECHNICAL SPECIFICATION No:		PE-TS-444/466/468-571-013-A001				
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
1	VENTILATION SYSTEM					
1.1	UAF					
1.1.1	UAF FAN (70000 CMH, 65MMWC Static)	1	0		1	
					TOTAL (KW)	

Note:

Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as **20.0 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 1,36,930/- (INR One Hundred Thirty-Six Thousand, Nine Hundred Thirty 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 **1,36,930/- (INR One Hundred Thirty-Six Thousand, Nine Hundred Thirty only)** per KW shall be levied on vendor.

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

Name	**Designation**	**Signature**	**DATE**	**Company Seal**

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

	ELECTRICAL FEEDER LIST	CUSTOMER: NTPC Limited							PROJECT NO. 466		
		JOB: KORBA FGD							Rev 00, DT: 17/01/2023, Rev 01, DT: 17/07/2023		
		SYSTEM: HVAC					Sl.No.:571-13000				
S No	TITLE	LOCATION	UNIT No	NAME PLATE kW	NO OF WORKING	NO OF STANDBY	CONTI/INT T	VOLTAGE CODE	LOAD CODE	REV. NO.	REMARKS
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~~	~~1~~	~~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	WALLL 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 PLENNUM			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	Contactor Controlled , 3 phase 4 wire
16	HEATER FOR CONDENSING UNIT - 2ND DROPPER (21200 CMH)			1.1	3	0	I	D	S	1	Contactor Controlled , 3 phase 4 wire
17	PAN HUMIDIFIER FOR CONDENSING UNIT			10	1	0	I	D	S	0	Contactor 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.	**GYPSUM DEWATERING BUILDING (ARCH.PLANS & 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	With SFU
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	With SFU
3	TOILET			0.1	2	0	C	E	S	0	
1	**NOTES:** **1. FOLLOWING BUILDINGS / AREAS OF THE BUILDINGS ARE OPEN TYPE & DOES NOT HAVE ANY WALL. ACCORDINGLY, VENTILATION SYSTEM IS NOT APPLICABLE.** **A) GA & PIPING LAYOUT IN & AROUND ACW / ECW PUMP SHED FOR FGD, 2100-109-PVM-F-048, PE-DG-466-181-M001 - SHED** **B)GYPSUM DEWATERING BUILDING (ARCHITECTURAL PLANS & FINISHING SCHEDULE), 2100-109-PVC-B-023 (CARRYING COMPRESSOR HOUSE & MCC AT 0.0M OF THE BUILDING), GROUND FLOOR (0.0M TO 10.0M) IS OPEN.** **C) RC PUMP & OXIDATION BLOWER HOUSE (GA & RC DETAILS OF FOUNDATIONS) - OPEN BUILDING** **D) GENERAL ARRANGEMENTS OF LIMESTONE DAY SILOS & WET BALL MILL BUILDING, 2100-109-PVM-B-021, 0-62-411-00014, BUILDING IS OPEN.** **2. VENTILATION SYSTEM FOR THE LIMENSTONE HANDLING SYSTEM, REVERSIBLE BELT FILTER SHALL BE IN BHEL ISG SCOPE.**										
2	**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** **** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)**										

	ELECTRICAL FEEDER LIST	CUSTOMER: NTPC Limited							PROJECT NO. 468		
		JOB: 2x250 MW BHILAI FGD							Rev 00, DT: 07/02/2020, Rev 01, DT: 27/04/2020,		
		SYSTEM: HVAC SYSTEM FOR FGD					SI.No.:571-13000		R02 - 12.01.2023, R03 - 17.07.2023		
S No	TITLE	LOCATION	UNIT No	NAME PLATE kW	NO OF WORKING	NO OF STANDBY	CONTI/INTT	VOLTAGE CODE	LOAD CODE	REV. NO	REMARKS
A.	FGD CONTROL ROOM, (ARCHITECTURAL PLANS), 9993-109-PVC-B-358, PE-DG-468-693-C001										
1	UAF FAN	FGD Control Room Roof	Station	22	1	0	C	D	U	1	High Inertia Fans (starting time greater than 5 Second).
2	MARINE LAMP FOR UAF	FGD Control Room Roof	Station	0.1	2	0	C	E	S	0	
3	UAF PUMPS	FGD Control Room Roof	Station	9.3	1	1	C	D	U	2	
4	~~CONTROL PANEL FOR UAF~~	~~FGD Control Room Roof~~	~~Station~~	~~2~~	~~1~~	~~0~~	~~C~~	~~E~~	~~S~~	3	
5	FIRE DAMPER FOR VENTILATION SYSTEM	Different Levels as per Ducting Layout	Station	0.1	4	0	C	E	S	2	Through DCS Control Panel, Electrical to communicate requirement to C&I
6	WALL MOUNTED AXIAL EXHAUST FAN FOR 220 V BATTERY ROOM AT 8.5 M	FGD Control Room Roof	Station	0.75	2	0	C	D	U	2	
7	WALL MOUNTED AXIAL EXHAUST FAN FOR 24 V BATTERY ROOM AT 8.5 M	FGD Control Room Roof	Station	0.75	2	0	C	D	U	2	
8	STORE ROOM, EL. 0.0 M, GRID 7-7A-B-C		Station	0.1	1	0	C	E	S	0	
9	LADIES TOILET, EL. 3.5 M, GRID 7-7A-B-C		Station	0.1	1	0	C	E	S	0	
10	GENTS TOILET, EL. 3.5 M, GRID 7-7A-B-C		Station	0.1	1	0	C	E	S	0	
11	UTILITY ROOM, EL. 8.5 M, GRID 7-7A-B-C		Station	0.1	1	0	C	E	S	0	
12	AIR HANDLING UNIT (AHU) FOR DX UNIT	AHU Room at FGD Control Room Roof	Station	11	1	1	C	D	U	2	High Inertia Fans (starting time greater than 5 Second).
13	AIR COOLED CONDENSING UNIT (DX UNIT)	FGD Control Room Roof	Station	60	1	1	C	D	S	2	3 Phase 4 Wire supply to be provided.
14	MARINE LAMP FOR AC DUCT PLENNUM	AHU Room at FGD Control Room Roof	Station	0.1	2	0	C	E	S	0	
15	FIRE DAMPER FOR AC SYSTEM	At AHU Room Floor Opening	Station	0.1	3	0	C	E	S	2	Through DCS Control Panel, Electrical to communicate requirement to C&I
16	HEATER FOR CONDENSING UNIT	AHU Room at FGD Control Room Roof	Station	1.67	3	0	I	D	S	2	Contactor Controlled , 3 phase 4 wire
17	PAN HUMIDIFIER FOR CONDENSING UNIT	AHU Room at FGD Control Room Roof	Station	3	1	0	I	D	S	2	Contactor Controlled , 3 phase 4 wire
~~18~~	~~FRESH AIR FAN FOR ABOVE AC ROOM~~	~~AHU Room at FGD Control Room Roof~~	~~Station~~	~~0.3~~	~~2~~	~~0~~	~~C~~	~~E~~	~~S~~	3	Either of the two feeders shall be used. The same shall be informed

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
LOAD CODE: U= Unidirectional Starter, B= Bidirectional Starter S= Supply Feeder

	ELECTRICAL FEEDER LIST	CUSTOMER: NTPC Limited							PROJECT NO. 468		
		JOB: 2x250 MW BHILAI FGD							Rev 00, DT: 07/02/2020, Rev 01, DT: 27/04/2020,		
		SYSTEM: HVAC SYSTEM FOR FGD					SI.No.:571-13000		R02 - 12.01.2023, R03 - 17.07.2023		
S No	TITLE	LOCATION	UNIT No	NAME PLATE kW	NO OF WORKING	NO OF STANDBY	CONTI/I NTT	VOLTAGE CODE	LOAD CODE	REV. NO	REMARKS
19	FRESH AIR FAN FOR ABOVE AC ROOM	AHU Room at FGD Control Room Roof	Station	0.75	2	0	C	D	U	3	after Fresh Air Fan document finalization.
B.	**9993-109-PVM-B-047 GENERAL ARRANGEMENTS OF LIMESTONE DAY SILOS & WET BALL MILL BUILDING**										
1	WALL MOUNTED AXIAL SUPPLY FAN FOR GRAVIMETRIC FEEDER VFD ROOM		Station	0.75	2	0	C	D	U	2	
2	SUPPLY AIR FAN FOR THE BUILDING		Station	1.5	2	0	C	D	U	2	
3	EXHAUST AIR FAN FOR THE BUILDING		Station	1.1	2	0	C	D	U	2	
4	PROPELLER FAN FOR TOILETS		Station	0.1	4	0	C	E	S	2	
C.	**GYPSUM DEWATERING BUILDING (ARCHITECTURAL PLANS & FINISHING SCHEDULE), 9993-109-PVC-B-370, PE-DG-468-694-C001**										
1	WALL MOUNTED SUPPLY FAN AT LIME STORAGE AREA AT 0.0M		Station	1.1	1	0	C	D	U	3	
2	WALL MOUNTED EXHAUST FAN AT LIME STORAGE AREA AT 0.0M		Station	0.55	1	0	C	D	U	3	
3	WALL MOUNTED AXIAL SUPPLY FAN AT 9.0 M AT BELT FILTER		Station	1.5	8	3	C	D	U	2	
4	RE Unit at 16.0 M		Station	2.2	3	1	C	D	U	2	
5	WALL MOUNTED AXIAL SUPPLY FAN AT 16.0 M GYPSUM HYDROCLONE AREA		Station	1.5	1	0	C	D	U	2	
6	WALL MOUNTED AXIAL EXHAUST FAN AT 16.0 M GYPSUM HYDROCLONE AREA		Station	0.55	1	1	C	D	U	2	
7	PROPPELLER FAN		Station	0.1	4	0	C	E	S	1	

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
LOAD CODE: U= Unidirectional Starter, B= Bidirectional Starter S= Supply Feeder

Project:	2x500 MW MOUDA TPP- FGD SYSTEM	Document:	Electrical Load List of HVAC SYSTEM
Package:	FGD SYSTEM PACKAGE	Doc. No.:	PE-V0-444-571-A413
Vendor:		Rev. No. : 01	Date 31.08.2021

S. No.	Description	Rating	kW / A	Supply type	Normal / Emergency	Feeder type	Working	Standby	Operation	Controlled from	Location	Recommended Cable size	Check with Data sheet (Yes / No)	Remarks
A	**FGD CONTROL ROOM**													
1	AIR COOLED CONDENSING UNIT 65 TR	120	KW	415 V ± 10% , 50 ± 5%, 3-Phase With Neutral	Normal Supply	S	1	1	Continous	DDCMIS	CONTROL ROOM	BHEL	Yes	
2	AHU FAN 32,500CFM	18.5	KW	415 V ± 10% , 50 ± 5%, 3-Phase With Neutral	Normal Supply	S	1	1	Continous	DDCMIS	CONTROL ROOM	BHEL	Yes	High inertia Fan
3	HEATER	9	KW	415 V ± 10% , 50 ± 5%, 3-Phase With Neutral, CONTRACTOR COTROLLED	Normal Supply	S	1	0	Intermittent	DDCMIS	CONTROL ROOM	BHEL	Yes	
4	HUMIDIFIER	4.5	KW	415 V ± 10% , 50 ± 5%, 3-Phase With Neutral , CONTRACTOR COTROLLED	Normal Supply	S	1	0	Intermittent	DDCMIS	CONTROL ROOM	BHEL	Yes	
5	FRESH AIR FAN	0.75	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	2	0	Continous	DDCMIS	CONTROL ROOM	BHEL	Yes	
6	Fire damper for AC system	0.5	KW	Single phase	Normal Supply	S	5	0	Continous	DDCMIS	CONTROL ROOM	BHEL		
7	Valve LCP	2	KW	416 V ± 10% , 50 ± 5%, 3-Phase With Neutral	Normal Supply	S	1	0	Continous	DDCMIS	CONTROL ROOM	BHEL	-	
8	UAF FAN	37	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	1	0	Continous	DDCMIS	CONTROL ROOM	BHEL	Yes	High inertia Fan
9	UAF PUMP	15	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	1	0	Continous	DDCMIS	CONTROL ROOM	BHEL	Yes	
10	Fire damper for Ventilation system	0.5	KW	Single phase	Normal Supply	S	10	0	Continous	DDCMIS	CONTROL ROOM	BHEL		
11	Exhaust Fan for 220 V Battery room	1.1	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	3	0	Continous		CONTROL ROOM	BHEL		
12	Exhaust Fan for 24 V Battery room	1.5	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	3	0	Continous		CONTROL ROOM	BHEL		
13	Propeller type exhaust Fan for Toilets and pantry	0.1	KW	Single phase	Normal Supply	S	6	0	Continous		CONTROL ROOM	BHEL		
B	COMPRESSOR HOUSE													
1	AXIAL FLOW SUPPLY FAN FOR COMPRESSOR HOUSE	1.5	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	3	0	Continous		ACW PUMP HOUSE	BHEL		
2	AXIAL FLOW EXHAUST FAN FOR COMPRESSOR HOUSE	0.75	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	3	0	Continous		ACW PUMP HOUSE	BHEL		
3	AXIAL FLOW SUPPLY FAN FOR MCC ROOM	1.5	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	3	0	Continous		ACW PUMP HOUSE	BHEL		

Project:	2x500 MW MOUDA TPP- FGD SYSTEM	**Document:**	Electrical Load List of HVAC SYSTEM
Package:	FGD SYSTEM PACKAGE	**Doc. No.:**	PE-V0-444-571-A413
Vendor:		**Rev. No. : 01**	Date 31.08.2021

S. No.	Description	Rating	kW / A	Supply type	Normal / Emergency	Feeder type	Working	Standby	Operation	Controlled from	Location	Recommended Cable size	Check with Data sheet (Yes / No)	Remarks
C	BALL MILL BUILDING													
1	AXIAL FLOW SUPPLY FAN	1.5	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	22	0	Continous		BALL MILL BUILDING	BHEL		
1	ROOF EXTRACTOR	5.5	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	4	0	Continous		BALL MILL BUILDING	BHEL		
D	GYPSUM DEWATERING BUILDING													
1	AXIAL FLOW SUPPLY FAN GROUND FLOOR	1.5	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	30	0	Continous		GYPSUM DEWATERING BUILDING	BHEL		
2	AXIAL FLOW EXHAUST FAN GROUND FLOOR	1.1	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	18	0	Continous		GYPSUM DEWATERING BUILDING	BHEL		
3	AXIAL FLOW SUPPLY FAN FIRST FLOOR	1.5	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	20	0	Continous		GYPSUM DEWATERING BUILDING	BHEL		
4	AXIAL FLOW EXHAUST FAN FIRST FLOOR	1.1	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	12	0	Continous		GYPSUM DEWATERING BUILDING	BHEL		
5	AXIAL FLOW SUPPLY FAN SECOND FLOOR	1.5	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	11	0	Continous		GYPSUM DEWATERING BUILDING	BHEL		
6	AXIAL FLOW EXHAUST FAN SECOND FLOOR	1.1	KW	415 V ± 10% , 50 ± 5%, 3-Phase	Normal Supply	U	8	0	Continous		GYPSUM DEWATERING BUILDING	BHEL		

Legend	
S. No.	Serial Number
KKS Code	Unique Number of the Equipment
Description	Description of the Equipment
Rating	Rating in kW or Amps
kW / A	Unit of 'Rating' i.e., kW or Amps
Supply type	Voltage & No. of phases
Normal / Eme	Normal Supply or Emergency Supply
Feeder type	Motor feeder or Heater feeder or SFU
Working / Sta	Normally working or standby
Operation	Continuous or Intermittent operation
Controlled fro	Controlled from DDCMIS or Local Starter or Local MCB switch (all in NTPC / BHEL scope)
Location	Location of the Eqiupment
Remarks	Any other relevant information

Notes: 1.	Electrical Load list shall be submitted as "Excel" sheet as per the format given above.
1	Each Row shall contain data of Only One equipment / load. i.e., if there are two numbers of the same equipment, they shall be indicated in two different rows with unique description & tag number.
2	Sample data has been filled in the format for reference.
3	Quantity for supply air fan, Exhaust air fan & propeller fan has been decided by NTPC/BHEL as per fan schedule.
4	DDCMIS , Motor Feeder , SFU feeder, DP MCB feeder & Local MCB switch shall be in NTPC / BHEL scope
5	Feeder List is prepared based on heat load submitted to BHEL.

MASTER DRAWING LIST WITH APPROVAL STATUS AND SCHEDULE OF SUBMISSION

MOUDA, KORBA, BHILAI TPS HVAC SYSTEM FOR FGD (SUPPLY+SERVICE) MASTER DRAWING LIST		
SL NO	**DESCRIPTION**	**APPROVAL STATUS**
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
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	APPROVED

	UNIT FOR FGD CONTROL BUILDING	
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

Drawings required for bidding purpose have been enclosed with the tender specification.

Notes:

a) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

b) 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.

c) Bidder to follow the following the drawing submission schedule:

d) 1st submission of drawings from date of LOI as per the submission schedule.

e) Every revised submission incorporating comments – within 7 days.

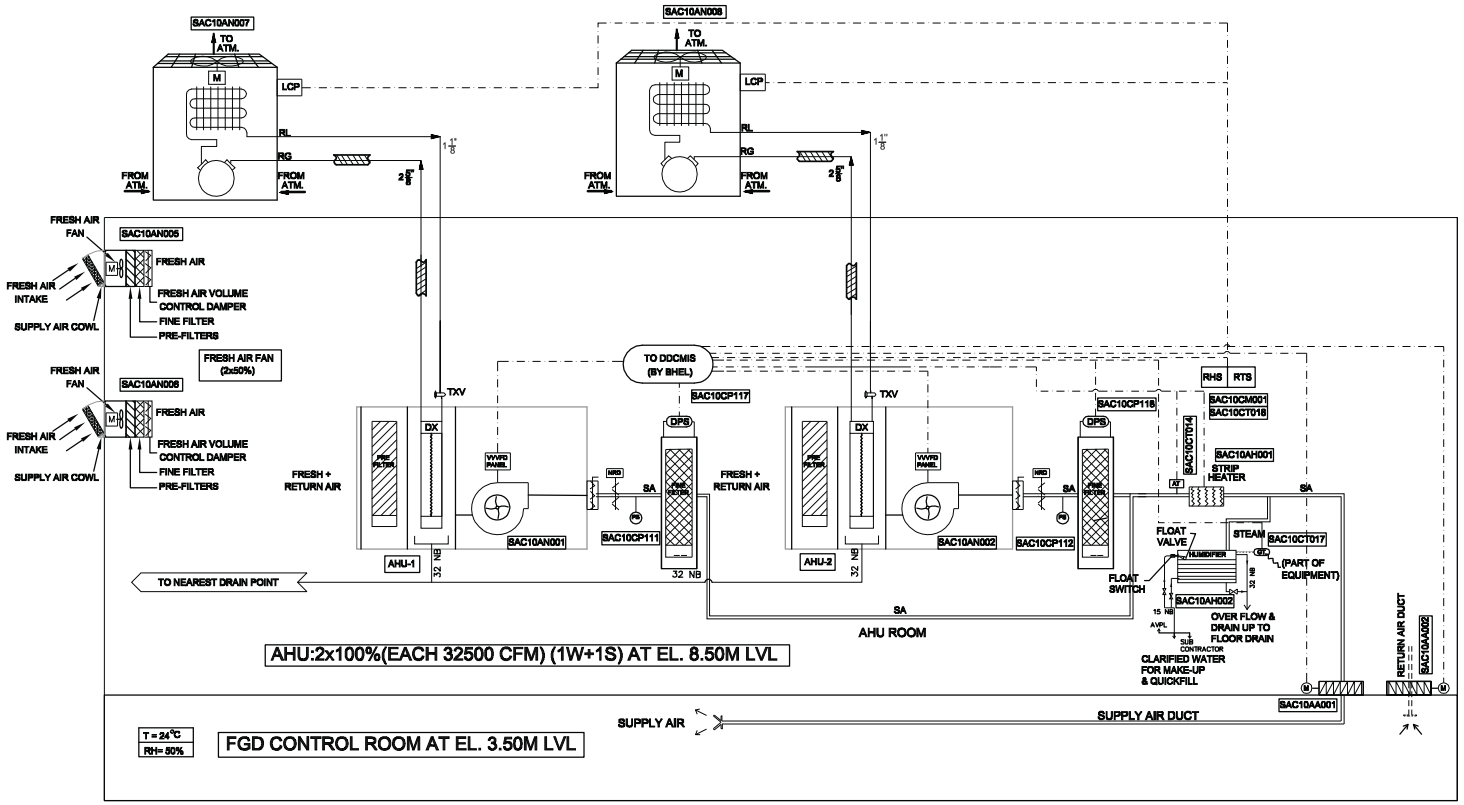
f) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute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

APPENDIX 1

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

AIR COOLED CONDENSING UNIT:2x100%(EACH 65 TR) (1W+1S) AT EL. 8.50M LVL



AHU:2x100%(EACH 32500 CFM) (1W+1S) AT EL. 8.50M LVL

P & I DIAGRAM FOR AIR COOLED CONDENSING UNIT (DX TYPE) FOR FGD CONTROL BUILDING

DETAILS OF FGD CONTROL BUILDING

DESCRIPTION	CAPACITY	QTY
AIR HANDLING UNIT	32500 CFM	2 NOS.(1W+1S)
AIR COOLED CONDENSING UNIT	65 TR	2 NOS.(1W+1S)
STRIP HEATER	6 KW	1 NO.(1W)
PAN HUMIDIFIER	4.5 KW	1 NO.(1W)
FRESH AIR FAN	1625 CFM	2 NOS(2W+0)

NOTES:

1. FOR LEGENDS & SYMBOLS, REFER BELOW GIVEN LEGEND LIST.
2. INSULATION WILL BE SUPPLIED AS PER APPROVED TDS DOCUMENT NO. 9561-109-PEM-PVM-Y-347
3. DRAINS TO BE ROUTED UPTO THE NEAREST DRAIN POINT.
4. CONDENSING/PACKAGE UNIT ,AHU, PAN HUMIDIFIER & FRESH AIR FAN CAPACITIES ARE AS PER HEAT LOAD CALCULATION.

REFERENCE DRAWINGS

TITLE	DRAWING NO.
HEAT LOAD CALCULATION FOR A/C SYSTEM OF FGD CONTROL BUILDING	9561-109-PEM-PVM-U-327

LEGENDS:

- TXV — THERMOSTATIC EXPANSION VALVE
- INSULATION
- CONTROL SIGNAL
- SUPPLY DUCT
- RETURN DUCT
- HUMIDIFIER
- STRIP HEATER
- SA - SUPPLY AIR
- RA - RETURN AIR
- FA - FRESH AIR
- FRESH AIR FAN WITH BIRD SCREEN AND COWL
- (SA) SUPPLY AIR GRILLE/DIFFUSER
- (RA) RETURN AIR GRILLE/DIFFUSER
- PREFILTER
- FINE FILTER
- NRD — NON RETURN DAMPER(NRD)
- MOTORISED FIRE DAMPER
- MANUAL VOLUME CONTROL DAMPER

INSTRUMENTS:

- GT — GYSERSTAT
- AT — AIRSTAT
- DPS — DIFFERENTIAL PRESSURE SWITCH
- RG — REFRIGERATION GAS
- RL — REFRIGERATION LIQUID
- LCP — LOCAL CONTROL PANEL
- RHS RTS — RETURN TEMP. & HUMIDITY SENSOR(TRANSMITTER TYPE)
- PS — PRESSURE SWITCH

NTPC DRG. No. 9561-109-PEM-PVM-B-289

PROJECT: 2 x 500 MW MOUDA STG-1 FGD

OWNER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT

JOB No.	444
STATUS	PROJECT
	CONTRACT

TD					
No.OFT					
REV	DATE	AL'TD	CHD	APPD	

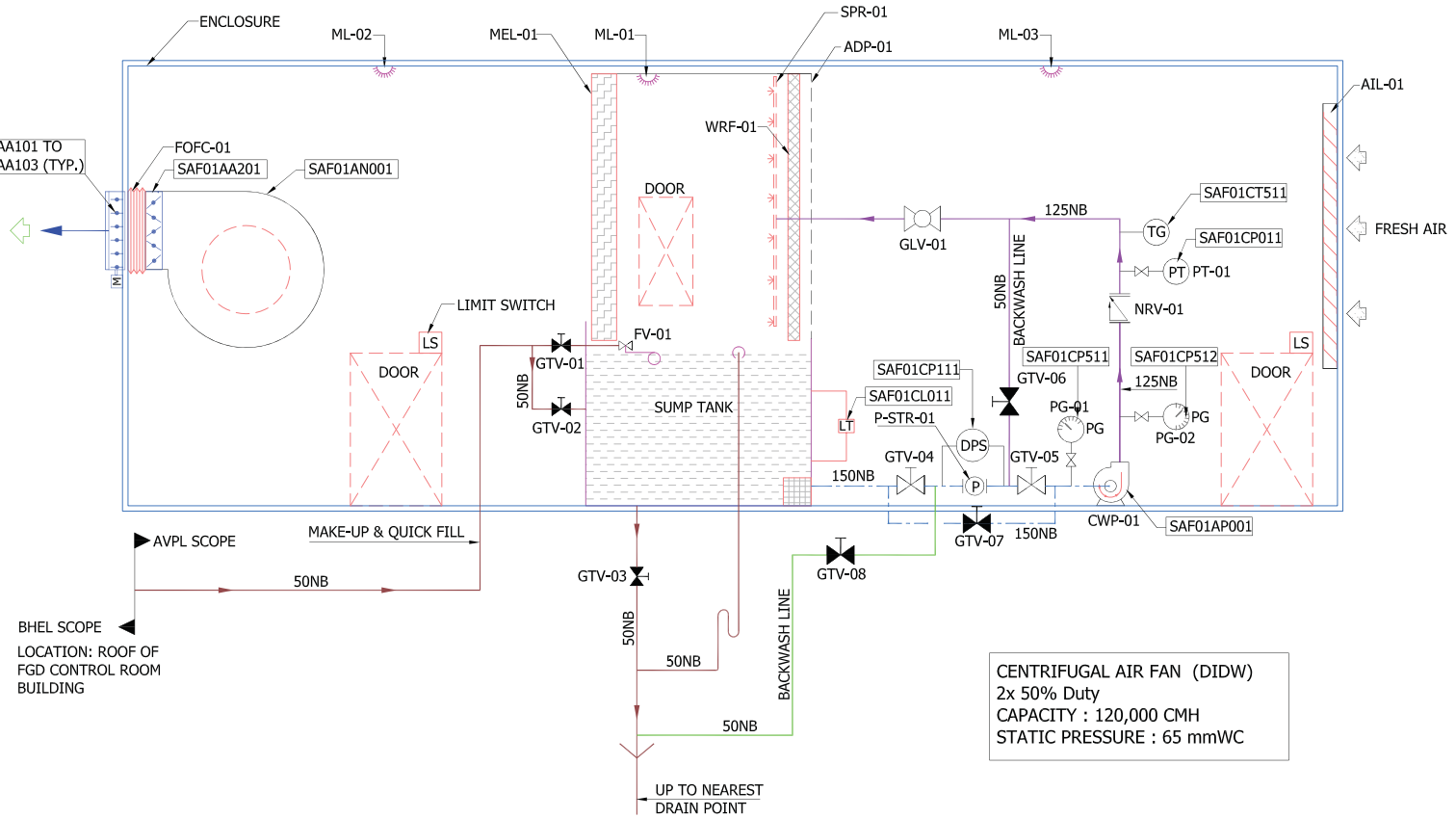
TITLE: P&I DIAGRAM FOR AIR COOLED CONDENSING UNIT (DX TYPE) FOR FGD CONTROL BUILDING

DEPT. | SCALE NTS | BHEL DRAWING NO. PE-VD-44A-571-A102

SIGN | DATE | AVPL DRG. No. AV2X21-81-P&ID-01

SHEET 1 OF 1 | REV. 00

SIZE-A4



CENTRIFUGAL AIR FAN (DIDW)
2x 50% Duty
CAPACITY : 120,000 CMH
STATIC PRESSURE : 65 mmWC

P & ID FOR UAF UNIT

NOTES:-

1. ALL DRAIN PIPING UP TO NEAREST DRAIN POINT SHALL BE IN AVPL SCOPE.
2. UAF FAN SHALL BE INTERCOCKED WITH THE FIRE PROTECTION PANEL.
3. SATURATION EFFICIENCY OF THE UAF UNIT SHALL BE MINIMUM 60%.
4. CAPACITY OF MACHINE IS ARRIVED BASED ON DOC. NO.2100-109-PVM-U-022A, HEAT LOAD CALCULATION FOR EVAPORATIVE COOLING SYSTEM FOR FGD CONTROL ROOM.
5. P& I WITH KKS TAGGING FOR UAF# 1 IS SHOWN IN THE DOCUMENT.FOR UAF#02, ONLY AREA KEY OF KKS TAGGING SHALL BE CHANGED FROM 01 TO I.E. SAF01 WILL CHANGE TO SAF02

S.N	LEGEND	DESCRIPTION	TAG NO	QTY/ UNIT
01		CENTRIFUGAL AIR FAN	CAF-01	01 No
02		VOLUME CONTROL DAMPER	VCD-01	01 No
03		FAN OUTLET FLEXIBLE CONNECTION	FOFC-01	01 No
04		AIR INTAKE LOUVER WITH BIRDMESH	AIL-01	01 SET
05		MIST ELIMINATOR	MEL-01	01 SET
06		WATER REPELANT TYPE FILTER	WRF-01	01 SET
07	PG	PRESSURE GAUGE	PG-01 & 02	02 Nos
08		GATE VALVE OPEN/CLOSE	GTV-01 TO 08	08 Nos
09		POT STRAINER	P-STR-01	01 No
10		COOLING WATER PUMP	CWP-01	01 No
11		MARINE LIGHT	ML-01 & 03	03 Nos
12		NON RETURN VALVE	NRV-01	01 No
13		AIR DISTRIBUTION PLATE	ADP-01	01 No
14	LT	LEVEL TRANSMITTER	LT-01	01 No
15	PT	PRESSURE TRANSMITTER	PT-01	01 No
16	DPS	DIFFERENTIAL PRESSURE SWITCH	DPS-01	01 No
17	TG	TEMPERATURE GAUGE	TG-01	01 No
18		GLOBE VALVE	GLV-01	01 No
19		DOOR	-	03 Nos
20		SPRAY NOZZLE	SPR-01	01 No
21	LS	LIMIT SWITCH	LS	02 Nos
22		SUCTION SCREEN	-	01 No

LINE LEGENDS:-

- MAKE-UP QUICKFILL LINE
- DRAIN & OVER FLOW LINE
- CIRCULATING WATER LINE/BACKWASH LINE
- CIRCULATING WATER LINE/BACKWASH LINE
- BACKWASH LINE

VALVE & INSTRUMENTS SCHEDULE:-

GATE VALVE	150 NB	03 Nos
GATE VALVE	50 NB	05 Nos
GLOBE VALVE	125 NB	01 No
NON RETURN VALVE	125 NB	01 No
PRESSURE TRANSMITTER		01 No
LEVEL TRANSMITTER		01 No
TEMPERATURE GAUGE		01 No
DIFFERENTIAL PRESSURE SWITCH		01 No
PRESSURE GAUGE		02 Nos
LIMIT SWITCH		02 Nos

REV. NO.	DESCRIPTION	DATE	DRN	CHKD	APPD
0	SUBMITTED FOR REVIEW / APPROVAL	06.01.2022			

NTPC DWG. NO. 2100-109-PVM-F-005B

CUSTOMER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT: 3X200+3x500+1x500 MW NTPC KORBA TPP (FGD SYSTEM PACKAGE)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

JOB NO.	466
STATUS	CONTRACT
DISTRIBUTION	

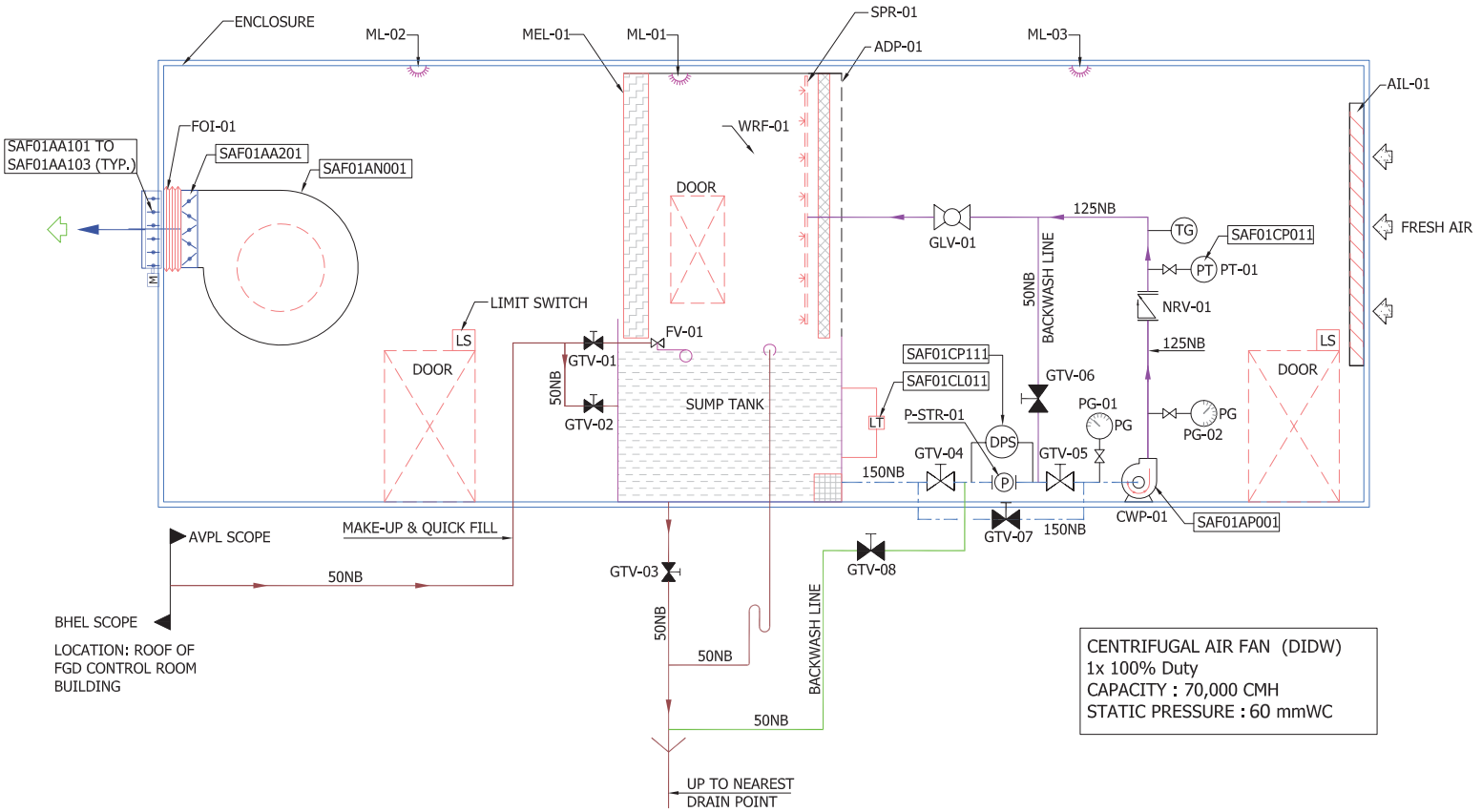
REV.	DATE	ALTD	CHD	APPD

DEPT CODE		NAME	SIGN	DATE
E	DRN			09.10.2021
	DESV			09.10.2021
	CHD			09.10.2021
	APPD			09.10.2021

TITLE: P&ID FOR UAF UNIT FOR FGD BUILDING

BHEL DOC. NO.: PE-W-466-571-13000-N-A104

DEPT. | SCALE: NTS | SIGN | DATE | SHEET: 1 OF 1 | REV.: 0 | SIZE: A2



CENTRIFUGAL AIR FAN (DIDW)
1x 100% Duty
CAPACITY : 70,000 CMH
STATIC PRESSURE : 60 mmWC

P & ID FOR UAF UNIT

NOTES:-

1. ALL DRAIN PIPING UP TO NEAREST DRAIN POINT SHALL BE IN AVPL SCOPE.
2. UAF FAN SHALL BE INTERCOCKED WITH THE FIRE PROTECTION PANEL.
3. CAPACITY OF MACHINE IS ARRIVED BASED ON DOC. NO.9993-109-PVM-B-369, HEAT LOAD CALCULATION FOR EVAPORATIVE COOLING SYSTEM FOR FGD CONTROL ROOM.

S.N	LEGEND	DESCRIPTION	TAG NO	QTY/ UNIT
01		CENTRIFUGAL AIR FAN	CAF-01	01 No
02		VOLUME CONTROL DAMPER	VCD-01	01 No
03		FAN OUTLET FLEXIBLE CONNECTION	FOFC-01	01 No
04		AIR INTAKE LOUVER WITH BIRDMESH	AIL-01	01 SET
05		MIST ELIMINATOR	MEL-01	01 SET
06		WATER REPELANT TYPE FILTER	WRF-01	01 SET
07		PRESSURE GAUGE	PG-01 & 02	02 Nos
08		GATE VALVE OPEN/CLOSE	GTV-01 TO 08	08 Nos
09		POT STRAINER	P-STR-01	01 No
10		COOLING WATER PUMP	CWP-01	01 No
11		MARINE LIGHT	ML-01 & 03	03 Nos
12		NON RETURN VALVE	NRV-01	01 No
13		AIR DISTRIBUTION PLATE	ADP-01	01 No
14	LT	LEVEL TRANSMITTER	LT-01	01 No
15	PT	PRESSURE TRANSMITTER	PT-01	01 No
16	DPS	DIFFERENTIAL PRESSURE SWITCH	DPS-01	01 No
17	TG	TEMPERATURE GAUGE	TG-01	01 No
18		GLOBE VALVE	GLV-01	01 No
19		DOOR	-	03 Nos
20		SPRAY NOZZLE	SPR-01	01 No
21	LS	LIMIT SWITCH	LS	02 Nos
22		SUCTION SCREEN	-	01 No

LINE LEGENDS:-

- MAKE-UP QUICKFILL LINE
- DRAIN & OVER FLOW LINE
- CIRCULATING WATER LINE/BACKWASH LINE
- CIRCULATING WATER LINE/BACKWASH LINE
- BACKWASH LINE

VALVE & INSTRUMENTS SCHEDULE:-

GATE VALVE	150 NB	03 Nos
GATE VALVE	50 NB	05 Nos
GLOBE VALVE	125 NB	01 No
NON RETURN VALVE	125 NB	01 No
PRESSURE TRANSMITTER		01 No
LEVEL TRANSMITTER		01 No
TEMPERATURE GAUGE		01 No
DIFFERENTIAL PRESSURE SWITCH		01 No
PRESSURE GAUGE		02 Nos
LIMIT SWITCH		02 Nos

REV. NO.	DESCRIPTION	DATE	DRN	CHKD	APPD
0	SUBMITTED FOR REVIEW / APPROVAL	05-01-2022	JB	F-J	F-J

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REVIEWED
By VIPIN NAUNI at 5:29 pm, Jul 08, 2022

JOB NO.	468
STATUS	CONTRACT
DISTRIBUTION	

REV.	DATE	ALTD	CHD	APPD

NTPC DWG. NO. 9993-109-PVM-B-302

CUSTOMER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT: 2 x 250 MW NSPCL BHILAI TPP FGD

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

ADVANCE VENTILATION PRIVATE LIMITED
101, HSIIDC Industrial Estate, KUNDLI - Sonepat (Haryana)

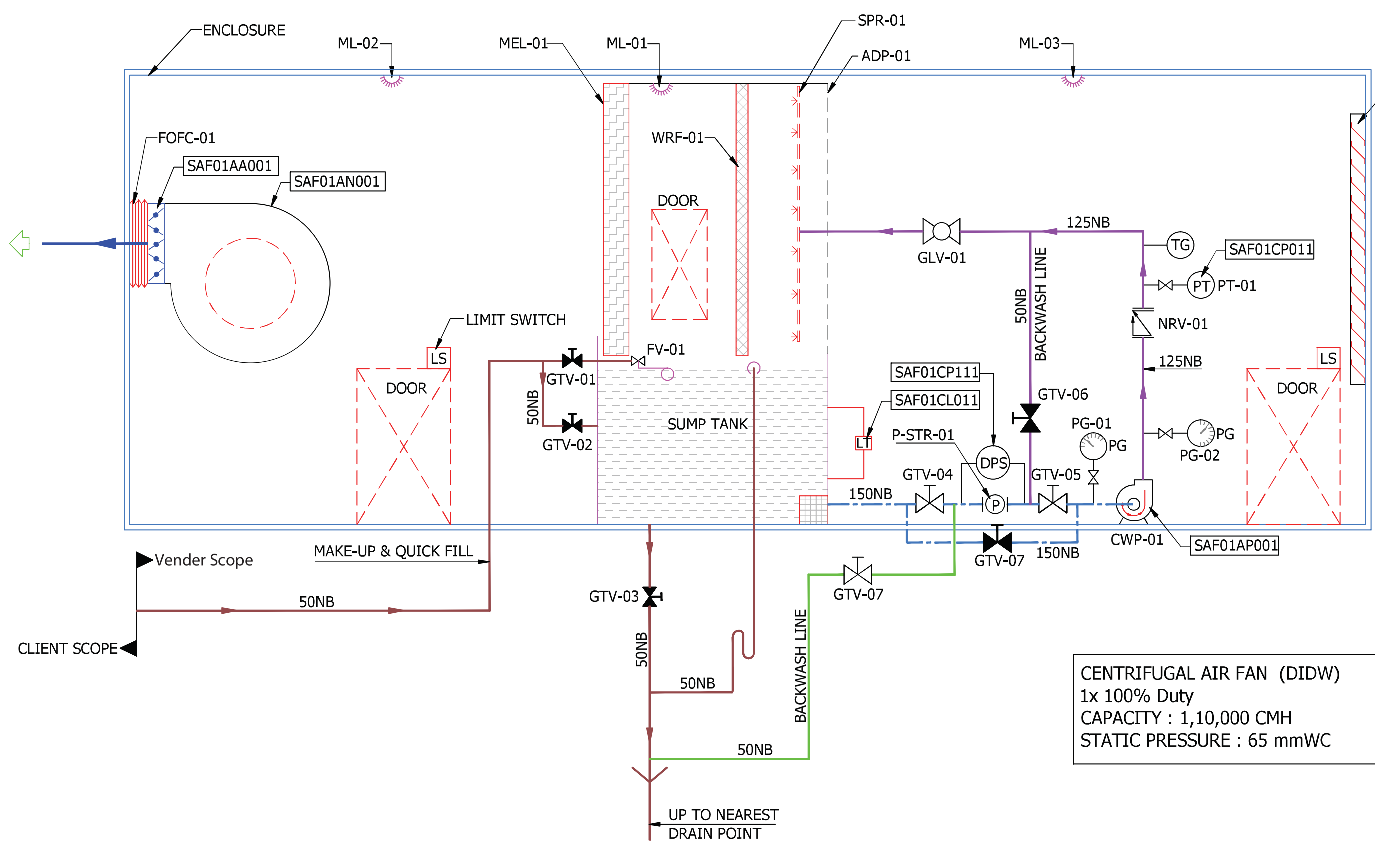
DEPT CODE		NAME	SIGN	DATE
E	DSGN	JB		31.01.2021
	DSGN	AG		31.01.2021
	CHD	F-J		31.01.2021
	APPD	F-J		31.01.2021

TITLE: P&ID FOR UAF UNIT FOR FGD BUILDING

DEPT.	SCALE	NTS
SIGN		
DATE		

BHEL DOC. NO. PE-V0-468-057-13000-A-A-A104

SHEET 1 OF 1 REV. 01 SIZE- A2



P & ID FOR UAF UNIT

NOTES:-

1. CASHING OF UAF SHALL BE DOUBLE SKIN OUTER 22G GALVANIZED INNER 20G GALVANIZED SANDWICH WITH 25MM THICK PU FOAM.
2. THE MS TANK FOR THE UAF UNIT SHALL BE 6 mm THICK.
3. SATURATION EFFICIENCY OF THE UAF UNIT SHALL BE MINIMUM 60%.
4. ALL PARTS SHALL BE PLACED ON MS CHANNEL AND DOUBLE SKIN CASING SHALL BE PROVIDED BELOW MS CHANNEL WITH COMPLETE ENCLOSURE OF UAF FROM BOTTOM ALSO.

S.N	LEGEND	DESCRIPTION	TAG NO	QTY/ UNIT
01		CENTRIFUGAL AIR FAN	CAF-01	01 No
02		VOLUME CONTROL DAMPER	VCD-01	01 No
03		FAN OUTLET FLEXIBLE CONNECTION	FOFC-01	01 No
04		AIR INTAKE LOUVER WITH BIRDMESH	AIL-01	01 SET
05		MIST ELIMINATOR	MEL-01	01 SET
06		WATER REPELANT TYPE FILTER	WRF-01	01 SET
07		PRESSURE GAUGE	PG-01 & 02	02 Nos
08		GATE VALVE OPEN/CLOSE	GTV-01 TO 07	07 Nos
09		POT STRAINER	P-STR-01	01 No
10		COOLING WATER PUMP	CWP-01	01 No
11		MARRINE LIGHT	ML-01 & 03	03 Nos
12		NON RETURN VALVE	NRV-01	01 No
13	------	AIR DISTRIBUTION PLATE	ADP-01	01 No
14	LT	LEVEL TRANSMITTER	LT-01	01 No
15	PT	PRESSURE TRANSMITTER	PT-01	01 No
16	DPS	DIFFERENTIAL PRESSURE SWITCH	DPS-01	01 No
17	TG	TEMPERATURE GAUGE	TG-01	01 No
18		GLOBE VALVE	GLV-01	01 No
19		DOOR	-	03 Nos
20		SPRAY NOZZLE	SPR-01	01 No
21	LS	LIMIT SWITCH	LS	02 Nos
22		SUCTION SCREEN	-	01 No

LINE LEGENDS:-

- MAKE-UP QUICKFILL LINE
- DRAIN & OVER FLOW LINE
- CIRCULATING WATER LINE/BACKWASH LINE
- CIRCULATING WATER LINE/BACKWASH LINE
- BACKWASH LINE

VALVE & INSTRUMENTS SCHEDULE:-

GATE VALVE	150 NB	03 Nos
GATE VALVE	50 NB	05 Nos
GLOBE VALVE	125 NB	01 No
NON RETURN VALVE	125 NB	01 No
PRESSURE TRANSMITTER		01 No
LEVEL TRANSMITTER		01 No
TEMPERATURE GAUGE		01 No
DIFFERENTIAL PRESSURE SWITCH		01 No
PRESSURE GAUGE		02 Nos
LIMIT SWITCH		02 Nos

REV. NO.	DESCRIPTION	DATE	DRN	CHKD	APPD
01	SUBMITTED FOR REVIEW / APPROVAL	02.04.2021	H.K	S.A	F.J
0	SUBMITTED FOR REVIEW / APPROVAL	19.03.2021	H.K	S.A	F.J

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NTPC DWG. NO. 9561-109-PEM-PVM-B-288

CUSTOMER: NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT: 2X500 MW MOUDA STG-I TPS FGD SYSTEM

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

JOB NO.	444
STATUS	CONTRACT
DISTRIBUTION	

REV.	DATE	ALTD	CHD	APPD

DEPT CODE		NAME	SIGN	DATE
E	DRN			
	DESN	H.K		19.03.2021
	CHD	S.A		19.03.2021
	APPD	F.J		19.03.2021

TITLE: P&ID FOR UAF UNIT FOR FGD BUILDING

DEPT. SCALE NTS SIGN DATE

BHEL DOC. NO. PE-V0-444-571-A104
AVPL DOC. NO. AV2K21-81-P&ID-02
SHEET 1 OF 1 REV. 01
SIZE- A2

Customer	NTPC	Job No.	M22/DEL-015.BHEL
Project	3X200+3X500+1x500 MW NTPC KORBA TPP-FGD	Date	10.11.2022
BHEL Doc. No.	PE-V0-466-(571-13000-A)-A203	NTPC Doc No	2100-109-PVM-Y-002A

Sr. No.	Description	Details
General Description		
1	Item	UAF
2	Manufacturer	
3	Model No.	UAF-120
4	Location	FGD Control Building
5	Type	Single bank spray nozzles with eliminators, louvers, distribution plate, Water repellent filters etc.
6	Air flow Capacity	120000 CMH
7	Fan Static pressure	65 mm WG
8	Quantity Offered	2 Nos.
9	Location	FGD Control Building
10	Overall Dimension	As per enclosed UAF GA drawing
11	Saturation Efficiency of UAF	70 % (min.)
12	Make up water requirement	2 CMH (max.)
Item Description		
1	Water repellent filter	Nylon type
2	No. of filter	610x610x50 mm -35 Nos. & 610x305x50 mm -5 Nos.
3	Water Eliminator	2 mm thk. PVC, 6 bend (Refer Note#1 of Document) R01
4	No. of Nozzles	224 Nos.
5	Size of Nozzles/Type	3/8" / Brass or Bronze with chrome plating
6	Pressure drop through Nozzle	1.4 to 2.4 kg/cm2
7	Capacity of each Nozzle	6.25 LPM
8	Cat walk/ ladder	Yes
9	Sump strainer	Yes
10	Inspection Window	Yes
11	Marine Light	Yes
Material of Construction		
1	Air Distribution Plate	Fabricated from 18G GI sheet & Galvanized Angle Support with minimum 50% free Area
2	Air Suction Screen	GI
3	UAF Casing/ Enclosure	Double Skin construction 22G GI outer Panel, 20G GI inner panel with 25mm PU foam Insulation Min. Density 38kg/M3
4	Water tank	MS Plate, 6 mm thk. Min. depth shall be 600mm
5	Capacity of Tank	6.08 m^3

6	Water Eliminator	100% virgin PVC
7	Water Spray Nozzle	Brass with Chrome Plating, Self-cleaning Type
8	Internal & drain Piping	GI as per IS:1239
9	External piping	Heavy grade as per IS:1239 upto 150 NB and MS as per IS:3589 for sizes above 200 NB
10	Support Structure	MS sections as per IS:2062
11	Centrifugal Fan:	For Details refer Technical Data Sheet of Centrifugal Fans for Air Handling Units and UAF Units (BHEL Doc.No:PE-V0-466-(571-13000-A) -A201) and (NTPC Doc. No.2100-109-PVM-Y-001A)
12	Centrifugal pump:	For Details refer Technical Data Sheet & GA Drawing for Centrifugal Pump for UAF Unit (BHEL Doc.No:PE-V0-466-(571-13000-A) -A204) and (NTPC Doc. No.2100-109-PVM-Y-002B)
Painting		
1	Casing/ Enclosure	Galvanized
2	Water tank	Spray galvanized, both inside and outside, min. 60 micron DFT
3	Support Structure	Epoxy with primer
Inspection & Testing		
1	Inspection & Testing	As per approved QAP

R01

Note#1

The PVC eliminators shall be UV stabilized 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.

APPLICABLE FOR
ANNEXURE-I, ITEM NO. B1b

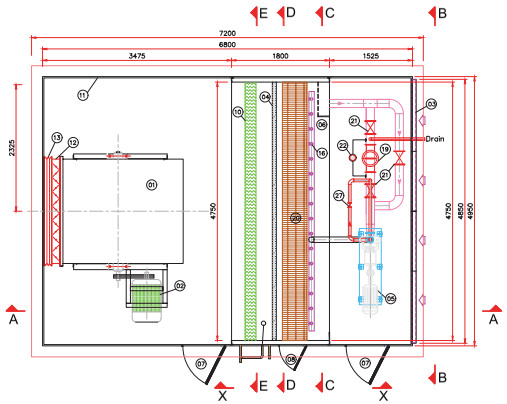
SUPPLY AIR FAN DETAIL	
AIR FLOW CAPACITY	:1,20,000 CMH
FAN STATIC PRESSURE	: 65 mmWC.
WATER PUMP DETAIL	
WATER FLOW CAPACITY	: 84 CMH
HEAD	: 30 Mtr.

NOTES:

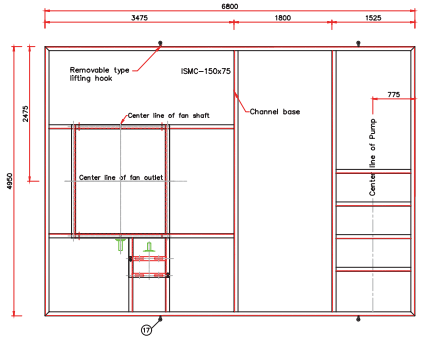
1. ALL EQUIPMENTS SHALL BE DESIGNED FOR CONTINUOUS DUTY.
2. ALL DIMENSIONS ARE IN MM, AND ELEVATIONS ARE IN MTRS. UNLESS OTHERWISE STATED.
3. ALL UNIT PIPE UP TO 150 mm SHALL BE HEAVY CLASS AS PER IS :1239
4. WATER DROPLETS / MIST ELIMINATORS SHALL BE MADE FROM RIGID PVC EXTRUDED PROFILES 6 BREAK TYPE.
5. SATURATION EFFICIENCY OF UAF UNIT SHALL BE MINIMUM 70% .
6. EQUIPMENT MAKE AS PER APPROVED SUB – VENDOR LIST."
7. ADEQUATE STIFFENERS SHALL BE PROVIDED ON UAF SIDE PANEL FOR TAKING CARE OF LOAD DURING OPERATION
8. SECONDARY CHANNELS SHALL BE PROVIDED IN BASE FRAME BASED ON EQUIPMENT LOCATION & REQUIREMENT

EQUIPMENT LOAD DETAILS :

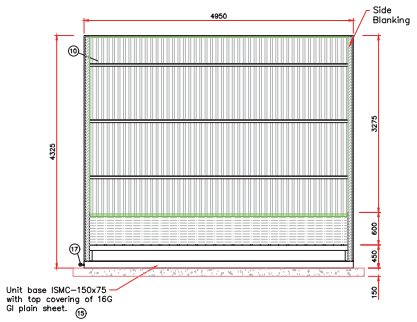
STATIC LOAD OF FAN & MOTOR WITH ACCESSORIES	:	1815 kg.
DYNAMIC LOAD OF FAN & MOTOR WITH ACCESSORIES	:	2725 kg.
STATIC LOAD OF PUMP & MOTOR WITH ACCESSORIES	:	450 kg.
DYNAMIC LOAD OF PUMP & MOTOR WITH ACCESSORIES	:	570 kg.
STATIC LOAD OF DOUBLE SKIN AWU ENCLOSER	:	5305 kg.
OPERATING LOAD OF AIR WASHER SECTION WITH WATER FILLED	:	5130 kg.
OPERATING LOAD OF COMPLETE AWU WITH FAN & PUMP	:	13730 kg.



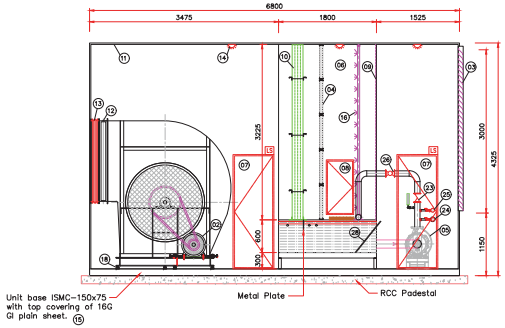
AWU PLAN WITH BACK SIDE AIR ENTRY



AWU UNIT STEEL BASE PLAN



SECTION E-E



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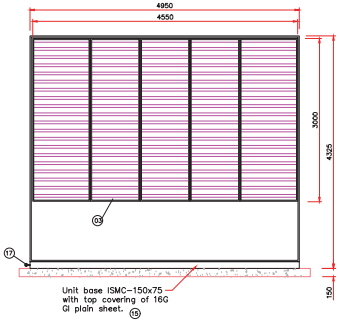

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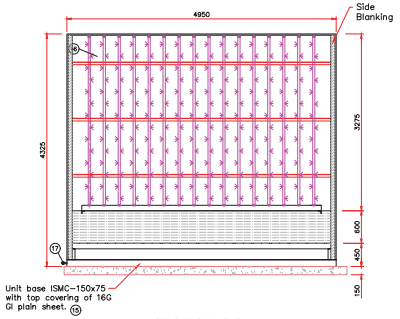
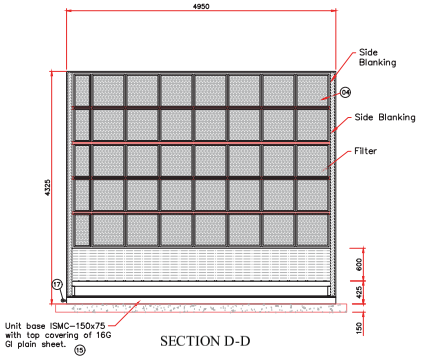
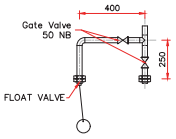


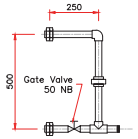
SECTION C-C



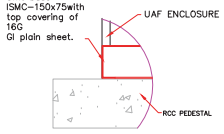
SECTION D-D



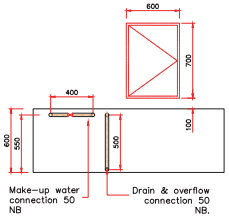
MAKE UP & QUICK FILL ASSEMBLY



DRAIN & OVER FLOW ASSEMBLY



UAF BASE FIXING DETAIL



SECTION X-X

BILL OF QUANTITY

PART NO.	DESCRIPTION	SIZE	QTY.	MAT'LS/MAKE
01.	SUPPLY AIR FAN Arr : Y(s)–A3		1 no.	
02.	MOTOR 37 kw/4 POLE	–	1 no.	As per Approved Make
03.	FRESH AIR INTAKE LOUVERS WITH BIRDMESH	4550x3000	1 set	GSS
04.	WATER REPELLANT TYPE NYLON FILTER	610x610x50/610x305x50	35 nos./05nos.	As per Approved TDS
05.	WATER RE CIRCULATING PUMP	84 CMH	1 nos.	Flowmore
06.	AIR WASHER SECTION (Spray section)	4750x1800x3225 ht.	1 no.	
07.	AIR TIGHT DOOR (Outside openable)	750x2100 (H)	2 nos.	
08.	AIR TIGHT WINDOW	600x700 (H)	1 no.	
09.	AIR DISTRIBUTION PLATE	4750x3225	1 no.	GSS
10.	WATER MIST ELIMINATOR	4750x3225	1 set.	–
11.	DOUBLE SKIN ENCLOSER	6800x4950x4325 ht.	1 no.	GSS
12.	FAN OUTLET DAMPER	1480x1918	1 no.	GSS
13.	FAN OUTLET FLEXIBLE CONNECTION	1480x1918	1 no.	CANVAS
14.	MARIN LAMP	100 watt.	3 nos.	PHILIPS
15.	ENCLOSER BASE	ISMC–150x75	1 no.	MS
16.	SPRAY NOZZLES	3/8"	224 nos.	BRASS/BRONZE WITH CHROME PLATED
17.	LIFTING HOOK (REMOVABLE TYPE)	M20	4 nos.	MS
18.	VIBRATION ISOLATORS	ECS–25/300	10 nos.	RESISTOFLEX
19.	POT STRAINER	150 NB	1 nos.	MS
20.	CAT WALK	450x4750	1 set	MS
21.	GATE VALVE	150	3 Nos	–
22.	DIFFERENTIAL PRESSURE SWITCH	–	1 Nos	–
23.	NON RETURN VALVE	125	1 Nos	–
24.	PRESSURE TRANSMITTER	–	1 Nos	–
25.	PRESSURE GAUGE	–	1 Nos	–
26.	GLOBE VALVE	125	1 Nos	–
27.	GATE VALVE	50	1 Nos	–
28.	SUCTION SCREEN	–	1 Nos	–

REV. NO.	DESCRIPTION	DATE	DRN	CHKD	APPD
0	SUBMITTED FOR REVIEW / APPROVAL	30.12.2022	D.S	A.GAUR	F.J
B	SUBMITTED FOR REVIEW / APPROVAL	07.09.2022	ND	A.GAUR	F.J
A	SUBMITTED FOR REVIEW / APPROVAL	04.08.2022	ND	A.GAUR	F.J

STAMP

NTPC DWG. NO. 2100-109-PVM-Y-002A

CUSTOMER

NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT

3X200+3x500+1x500 MW NTPC KORBA TPP
(FGD SYSTEM PACKAGE)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

TITLE

TECHNICAL DATA SHEET GA DRAWING OF UAF UNIT

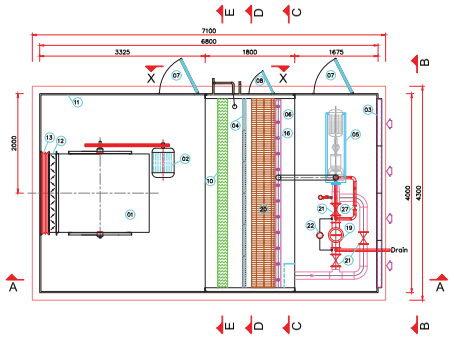
DEPT.	SCALE NTS	BHEL DOC. NO.	PE-V0-466-(571-13000-A)-A203	
SIGN				
DATE		SHEET 1 OF 1	REV. 0	SIZE: A2

Customer	**NTPC**	**Job No.**	**M22/DEL-027.BHEL**
Project	**2 X 250 MW NSPCL BHILAI TPP-FGD**	**Date**	17.10.2022
BHEL Doc. No.	**PE-V0-468-(571-13000-A)-A203**	**NTPC Doc No**	**9993-109-PVM-B-482**

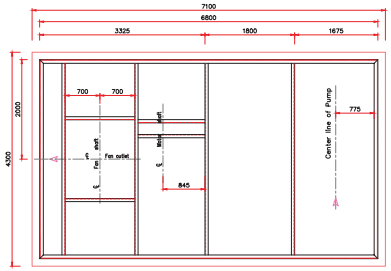
Sr. No.	Description	Details
General Description		
1	Item	UAF
2	Manufacturer	
3	Model No.	UAF-70
4	Location	FGD Control Building
5	Type	Single bank spray nozzles with eliminators, louvers, distribution plate, Water repellent filters etc.
6	Air flow Capacity	70,000 CMH
7	Fan Static pressure	65 mm WG
8	Quantity Offered	1 No.
9	Location	FGD Control Building
10	Overall Dimension	As per enclosed UAF GA drawing
11	Saturation Efficiency of UAF	70 % (min.)
12	Make up water requirement	2 CMH (max.)
Item Description		
1	Water repellent filter	Nylon type
2	No. of filter	610x610x50 mm -24 Nos.
3	Water Eliminator	2 mm thk. PVC, 6 bend
4	No. of Nozzles	144 Nos.
5	Size of Nozzles/Type	3/8" / Brass or bronze with crome plating
6	Pressure drop through Nozzle	1.4 to 2.4 kg/cm2
7	Capacity of each Nozzle	6 LPM
8	Cat walk/ ladder	Yes
9	Sump strainer	Yes
10	Inspection Window	Yes
11	Marine Light	Yes
Material of Construction		
1	Air Distribution Plate	Fabricated from 18G GI sheet & Galvanized Angle Support with minimum 50% free Area
2	Air Suction Screen	GI
3	UAF Casing/ Enclosure	Double Skin construction 22G GI outer Panel, 20G GI inner panel with 25mm PU foam Insulation Min. Density 38kg/M3
4	Water tank	MS Plate, 6 mm thk. Min. depth shall be 600mm
5	Capacity of Tank	3.3 m^3

6	Water Eliminator	Minimum finished thickness of 2 mm. The PVC eliminators shall be UV stabilized 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.
7	Water Spray Nozzle	Brass with Chrome Plating, Self-cleaning Type
8	Internal & drain Piping	GI as per IS:1239
9	External piping	Heavy grade as per IS:1239 upto 150 NB and MS as per IS:3589 for sizes above 200 NB
10	Support Structure	MS sections as per IS:2062
11	Centrifugal Fan	For details refer TECHNICAL DATA SHEET OF CENTRIFUGAL FANS FOR AIR HANDLING UNITS AND UAF UNITS (PE-V0-468-(571-13000-A)-A201 NTPC NO. 9993-109-PVM-B-481
12	Centrifugal Pump	For details refer TECHNICAL DATA SHEET & GA DRAWING FOR CENTRIFUGAL PUMP FOR UAF UNIT (PEV0-468-(571-13000-A)-A204) NTPC NO: 9993-109-PVM-B-269
Painting		
1	Casing/ Enclosure	Galvanized
2	Water tank	Spray galvanized, both inside and outside, min. 60 micron DFT
3	Support Structure	Epoxy with primer
Inspection & Testing		
1	Inspection & Testing	As per approved QAP

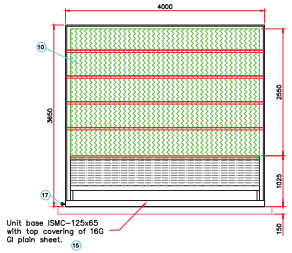
APPLICABLE FOR
ANNEXURE-I, ITEM NO. B1a



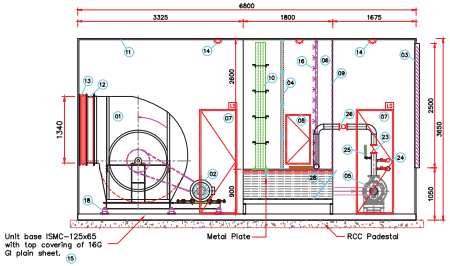
UAF PLAN WITH BACK SIDE AIR ENTRY



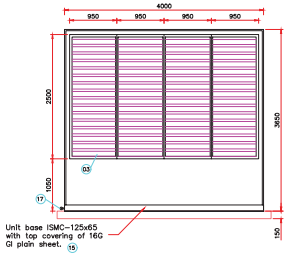
UAF UNIT STEEL BASE PLAN



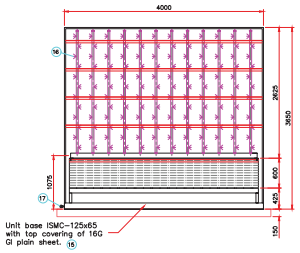
SECTION E-E



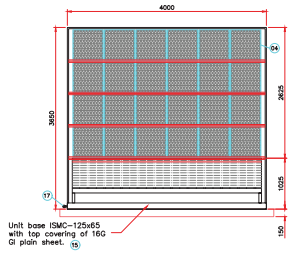
SECTION A-A



SECTION B-B



SECTION C-C



SECTION D-D

NOTES:

1. ALL EQUIPMENTS SHALL BE DESIGNED FOR CONTINUOUS DUTY.
2. ALL DIMENSIONS ARE IN MM, AND ELEVATIONS ARE IN MTRS. UNLESS OTHERWISE STATED.
3. AIR WASHER UNIT PIPING UP TO 150mm SHALL BE GI HEAVY CLASS AS PER IS:1239.
4. WATER DROPLETS / MIST ELIMINATORS SHALL BE MADE FROM RIGID PVC ESTRUDED PROFILES 6 BREAK TYPE.
5. SATURATION EFFICIENCY OF UAF UNIT SHALL BE MINIMUM 70%.
6. ROTATION OF SUPPLY AIR FAN, LOCATION OF AIR INTAKE LOUVERS & SIZE OF INTAKE LOUVERS WILL BE DECIDED AS PER APPROVED EQUIPMENT LAYOUTS DRAWINGS.
7. EQUIPMENT MAKE AS PER APPROVED SUB – VENDOR LIST.
8. REFER AWU LAYOUT DRAWINGS FOR SIZE OF FRESH AIR INTAKE LOUVERS.
9. ADEQUATE STIFFNERS AS PER REQUIREMENT SHALL BE PROVIDED ON UAF SIDE PANLES FOR TAKING CARE OF LOAD DURING OPERATION.

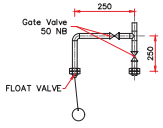
SUPPLY AIR FAN DETAIL	
AIR FLOW CAPACITY	:70,000 CMH
FAN STATIC PRESSURE	: 65 mmWC.
WATER PUMP DETAIL	
WATER FLOW CAPACITY	: 50 CMH
HEAD	: 30 Mtr.

EQUIPMENT LOAD DETAILS :

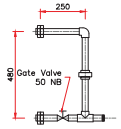
STATIC LOAD OF FAN & MOTOR WITH ACCESSORIES	:	1275 kg.
DYNAMIC LOAD OF FAN & MOTOR WITH ACCESSORIES	:	1915 kg.
STATIC LOAD OF PUMP & MOTOR WITH ACCESSORIES	:	350 kg.
DYNAMIC LOAD OF PUMP & MOTOR WITH ACCESSORIES	:	525 kg.
STATIC LOAD OF DOUBLE SKIN AWU ENCLOSER	:	2255 kg.
OPERATING LOAD OF AIR WASHER SECTION WITH WATER FILLED	:	6000 kg.
OPERATING LOAD OF COMPLETE AWU WITH FAN & PUMP	:	11825 kg.

BILL OF QUANTITY

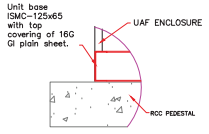
PART NO.	DESCRIPTION	SIZE	QTY.	MATLS/MAKE
01.	SUPPLY AIR FAN Arr : Y(e)–A3		1 no.	
02.	MOTOR 22 KW/4 POLE	–	1 no.	As per Approved Make
03.	FRESH AIR INTAKE LOUVERS WITH BIRDMESH	As per layout dwg.	1 set	GSS
04.	AIR PRE FILTERS	610x610x50	24 nos.	Water repellant Nylon
05.	WATER RE CIRCULATING PUMP	50 CMH	1 nos.	Flowmore
06.	AIR WASHER SECTION (Spray section)	3800x1800x2600 ht.	1 no.	
07.	AIR TIGHT DOOR (Outside openable)	750x2100 (H)	2 nos.	
08.	AIR TIGHT WINDOW (Air Washer section)	500x1000 (H)	1 no.	
09.	AIR DISTRIBUTION PLATE	3800x2550	1 no.	GSS
10.	WATER MIST ELIMINATOR	3800x2550	1 set.	–
11.	DOUBLE SKIN ENCLOSER	6800x4000x3650ht.	1 no.	GSS
12.	FAN OUTLET DAMPER	1340x1578	1 no.	GSS
13.	FAN OUTLET FLEXIBLE CONNECTION	1340x1578	1 no.	CANVAS
14.	MARIN LAMP	100 watt.	3 nos.	PHILIPS
15.	ENCLOSER BASE	ISMC–125x65	1 no.	MS
16.	SPRAY NOZZLES	3/8"	144 nos.	As per TDS
17.	LIFTING HOOK (REMOVABLE TYPE)	M20	4 nos.	MS
18.	VIBRATION ISOLATORS	ECS–25/300	10 nos.	RESISTOFLEX
19.	POT STRAINER	150 NB	1 nos.	MS
20.	CAT WALK	450x3800	1 set	MS
21.	GATE VALVE	150 NB	3 Nos	–
22.	DIFFERENTIAL PRESSURE SWITCH	–	1 Nos	–
23.	NON RETURN VALVE	100 NB	1 Nos	–
24.	PRESSURE TRANSMITTER	–	1 Nos	–
25.	PRESSURE GAUGE	–	1 Nos	–
26.	GLOBE VALVE	100 NB	1 Nos	–
27.	GATE VALVE	50 NB	1 Nos	–
28.	SUCTION SCREEN	–	1 Nos	–



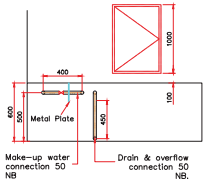
MAKE UP & QUICK
FILL ASSEMBLY



DRAIN & OVER FLOW
ASSEMBLY



UAF BASE FIXING
DETAIL



SECTION X-X

REVIEWED
By VIPIN NAUNI at 9:59 am, Oct 18, 2022

JOB NO.	468
STATUS	CONTRACT
DISTRIBUTION	

REV.	DATE	ALTD	CHD	APPD

NTPC DWG. NO. 9993-109-PVM-B-482

CUSTOMER NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT 2 x 250 MW NSPCL BHILAI TPP FGD

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

TITLE
TECHNICAL DATA SHEET GA DRAWING OF UAF UNIT

DEPT.	SCALE	NTS	BHEL DOC. NO.
SIGN			PE-V0-468-(571-13000-A)-A203
DATE			SHEET 1 OF 1 REV. 0

SIZE: A2

TECHNICAL DATASHEET & GA DRAWING OF UAF UNIT

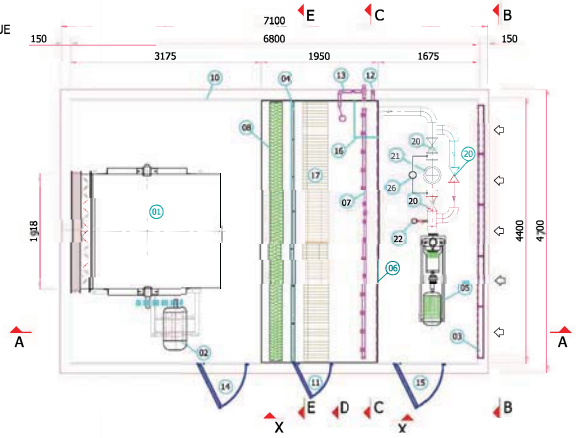
Customer	**NTPC**	**Job No.**	**M21/DEL-81.BHEL**
Project	**3X500 MW MOUDA TPP STAGE-I (FGD SYSTEM PACKAGE)**	**Date**	**23.08.2021**
BHEL Doc. No.	**PE-V0-444-571-A203**		

Sr. No.	Description	Details
General Description		
1	Item	UAF
2	Manufacturer	
3	Model No.	UAF-110
4	Type	Single bank spray nozzles with eliminators, louvers, distribution plate, Water repellent filters etc.
5	Air flow Capacity	110000 CMH
6	Fan Static pressure	65 mm WG
7	Quantity Offered	1 Nos.
8	Location	FGD Control Building
9	Overall Dimension	As per enclosed UAF GA drawing
10	Saturation Efficiency of UAF	60 % (min.)
11	Make up water requirement	2 CMH (max.)
Item Description		
1	Water repellent filter	Nylon type
2	No. of filter	610x610x50 mm - 35 Nos.
3	Water Eliminator	2 mm thk. PVC, 6 bend
4	No. of Nozzles	196 Nos.
5	Size of Nozzles	3/8"
6	Pressure drop through Nozzle	1.4 to 2.4 kg/cm2
7	Capacity of each Nozzle	6 LPM
8	Cat walk/ ladder	Yes
9	Sump strainer	Yes
10	Inspection Window	Yes
11	Marine Light	Yes
Material of Construction		
1	Air Distribution Plate	Fabricated from 18G GI sheet & Galvanized Angle Support with minimum 50% free Area
2	Air Suction Screen	GI
3	UAF Casing/ Enclosure	Double Skin construction 22G GI outer Panel, 20G GI inner panel with 25mm PU foam Insulation Min. Density 38kg/M3
4	Water tank	MS Plate, 6 mm thk. Min. depth shall be 600mm
5	Capacity of Tank	5.44 m^3

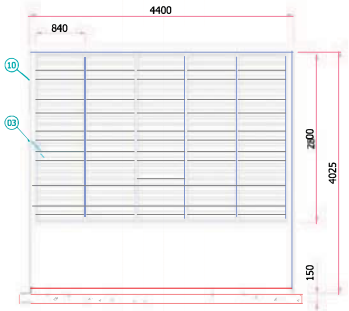
6	Water Eliminator	100% virgin PVC, 2mm thk., 6 bend
7	Water Spray Nozzle	Brass with Chrome Plating, Self-cleaning Type
8	Internal & drain Piping	GI as per IS:1239
9	External piping	Heavy grade as per IS:1239 upto 150 NB and MS as per IS:3589 for sizes above 200 NB
10	Support Structure	MS sections as per IS:2062
Painting		
1	Casing/ Enclosure	Galvanized
2	Water tank	Spray galvanized, both inside and outside, min. 60 micron DFT
3	Support Structure	Epoxy with primer
Inspection & Testing		
1	Inspection & Testing	As per approved QAP

APPLICABLE FOR ANNEXURE-I, ITEM NO. B1c

PLANT/TRUE NORTH



PLAN VIEW- UAF110



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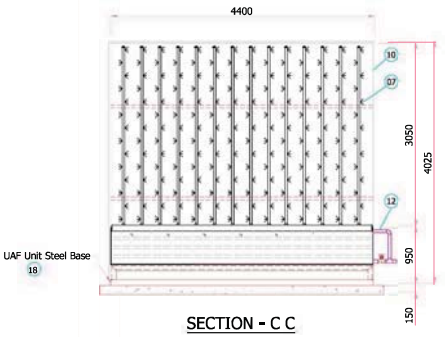

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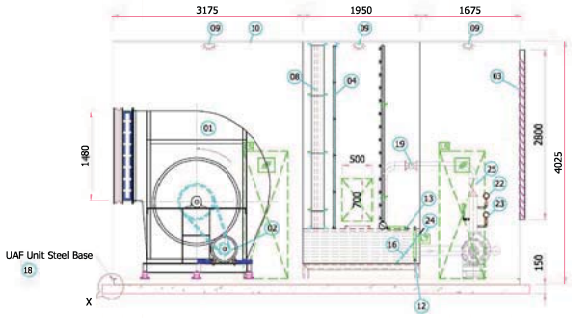
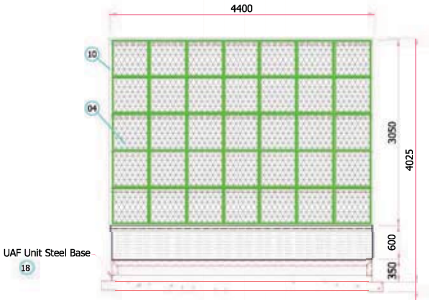


SECTION A-A



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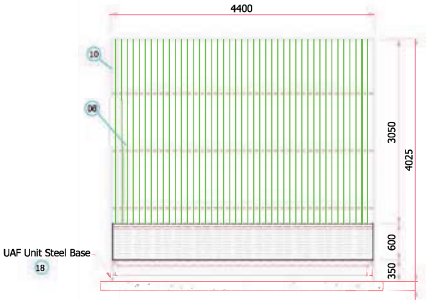
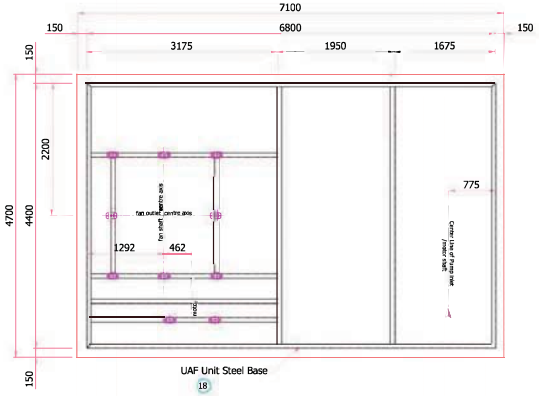
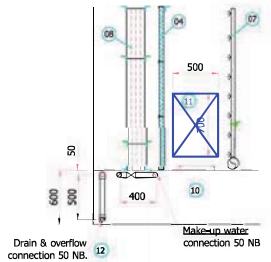


SECTION - D D



PLAN VIEW - RCC FOUNDATION FOR UAF-110



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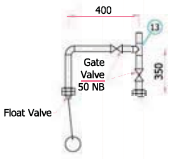
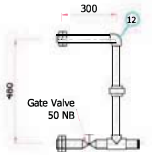
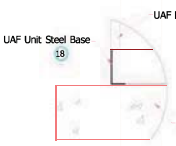


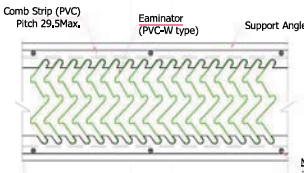
MAKE UP & QUICK FILL ASSEMBLY



DRAIN & OVER FLOW ASSEMBLY



UAF BASE FIXING DETAIL



ELEMINATOR FIXING DETAIL

M8x20 long bolt to join the angle & comb strip.

REFERENCE DRAWING

S.NO	REFERENCE DRAWING NO-	TITLE
01.	9558-109-146-PVM-U-002	HEAT LOAD CALCULATION FOR EVAPORATIVE COOLING SYSTEM OF FGD BUILDING.
02.	9558-109-146-PVM Y-001	TDS & GA OF CENTRIFUGAL FAN FOR AHU & UAF.
03.	PE-VO-442-571-A204	TDS & GA OF PUMP.

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS & ELEVATIONS ARE IN METERS UNLESS MARKED OTHERWISE.
2. WATER DROPLETS / MIST ELIMINATORS SHALL BE MADE FROM 100% VIRGIN PVC OF MINIMUM FINISH THICKNESS OF 2 MM.
3. UAF CASING SHALL BE DOUBLE SKIN CONSTRUCTION. DOUBLE SKIN PANEL SHALL BE MADE OF 22 SWG. GI SHEET ON OUTER SIDE AND 20 SWG. GI SHEET ON INNER SIDE WITH 25 MM POLYURETHANE FOAM.
4. UAF TANK SHALL BE MADE FROM 6 MM THICK MS AND INSIDE & OUTSIDE SURFACE OF THE TANK SHALL BE SPRAY GALVANIZED (MINIMUM 60 MICRONS DFT).
5. UAF SPRAY SYSTEM SHALL CONSIST OF M S GALVANIZED PIPE AS PER IS:1239 HEAVY DUTY.
6. SATURATION EFFICIENCY OF UAF SHALL BE MINIMUM 60%.

UAF CAPACITY	:	1,10,000 CMH
STATIC PRESSURE	:	65 mmWC
QTY.	:	1 NO.

PUMP CAPACITY	:	80 CMH
HEAD	:	30 mmWC
QTY.	:	1 NO.

UNIT	STATIC LOAD	DYNMIC LOAD
UAF INCLUDING WATER TANK	8500 Kg. (APPROX.)	-
FAN + MOTOR	1994 Kg. (APPROX.)	3000 Kg. (APPROX.)
PUMP + MOTOR	450 Kg. (APPROX.)	580 Kg. (APPROX.)
TOTAL LOAD ON PEDESTAL	11500 Kg. (APPROX.)	

P .NO.	DESCRIPTION	SIZE	QTY.	MAT'LS/MAKE
27.	TEMPERATURE GAUGE	"	1 no.	"
26.	DIFFERENTIAL PRESSURE SWITCH	"	1 no.	"
25.	NON RETURN VALVE	125 NB	1 no.	"
24.	LEVEL TRANSMITTER	"	1 no.	"
23.	PRESSURE TRANSMITTER	"	1 no.	"
22.	PRESSURE GAUGE	"	2 nos.	"
21.	POT - STRAINER	150 NB	1 no.	"
20.	GATE VALVE	150 NB	3 nos.	"
19.	GLOBE VALVE	125 NB	1 no.	"
18.	UAF UNIT BASE FRAME (MS CHANNEL)	6800x4400	1 set.	
17.	CAT WALK	450x4300	1 set.	
16.	SUCTION SCREEN	"	1 no.	
15.	AIR TIGHT DOOR WITH INSPECTION GLASS & LIMIT SWITCH	750x2100	1 no.	
14.	AIR TIGHT DOOR WITH INSPECTION GLASS & LIMIT SWITCH	750x2100	1 no.	
13.	MAKE UP QUICK FILL WATER CONNECTION	50NB.	1 set.	
12.	DRAIN & OVER FLOW CONNECTION	50NB.	1 set.	
11.	AIR TIGHT DOOR FOR SPRAY SECTION	500x700	1 no.	
10.	UAF ENCLOSURE (DOUBLE SKIN TYPE - 25 MM)	6800x4400x4025 Ht.	1 no.	
09.	MARINE LAMP	100 watt.	3 nos.	
08	MIST ELEMINATOR LOUVERS	4300x3050Ht.	1 set.	
07.	WATER SPRAY NOZZLES	3/8"	196 nos.	
06.	AIR DISTRIBUTION PLATE	4300x3050Ht.	1 no.	
05.	WATER RE-CIRCULATION PUMP	81 CMH	1 no.	
04.	WATER REPELLENT FILTERS	610x610x50	35 nos.	
03.	FRESH AIR LOUVER WITH BIRDMESH	840x2800 Ht.	5 nos.	
02.	MOTOR 37 KW/6 POLE	"	1 no.	
01.	SUPPLY AIR FAN : FORM OF FAN : C3	AdLD-137	1 no.	

REV. NO.	DESCRIPTION	DATE	DRN	CHKD	APPD
01	SUBMITTED FOR REVIEW / APPROVAL	13.08.2021	H.K	S.A	A.G
0	SUBMITTED FOR REVIEW / APPROVAL	19.03.2021	Y.A	S.A	F.J

STAMP

NTPC DWG. NO. 9561-109-PEM-PVM-B-306

CUSTOMER NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT 2X500 MW NTPC MOUDA TPP STAGE -1(FGD SYSTEM PACKAGE)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

JOB NO. 444
STATUS CONTRACT
DISTRIBUTION

REV.	DATE	ALTD	CHD	APPD

DEPT CODE		NAME	SIGN	DATE
	DRN	Y.A		23.06.2021
	CHD	S.A		23.06.2021
	APPD	F.J		23.06.2021

TITLE: TECHNICAL DATA SHEET & GA DRAWING OF UAF UNIT

DEPT. | SCALE NTS | BHEL DOC. NO. PE-VO-444-071-A203
SIGN
DATE
SHEET 1 OF 1 | REV. 01
SIZE- A2

APPLICABLE FOR
ANNEXURE-I, ITEM NO.
B1b & B1c

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

Sr.No.	Description	Details
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/cm³
7	**Material of Construction**	
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/cm²
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.

QUALITY ISO ASSURED 9001 PRODUCTS

CE Certified

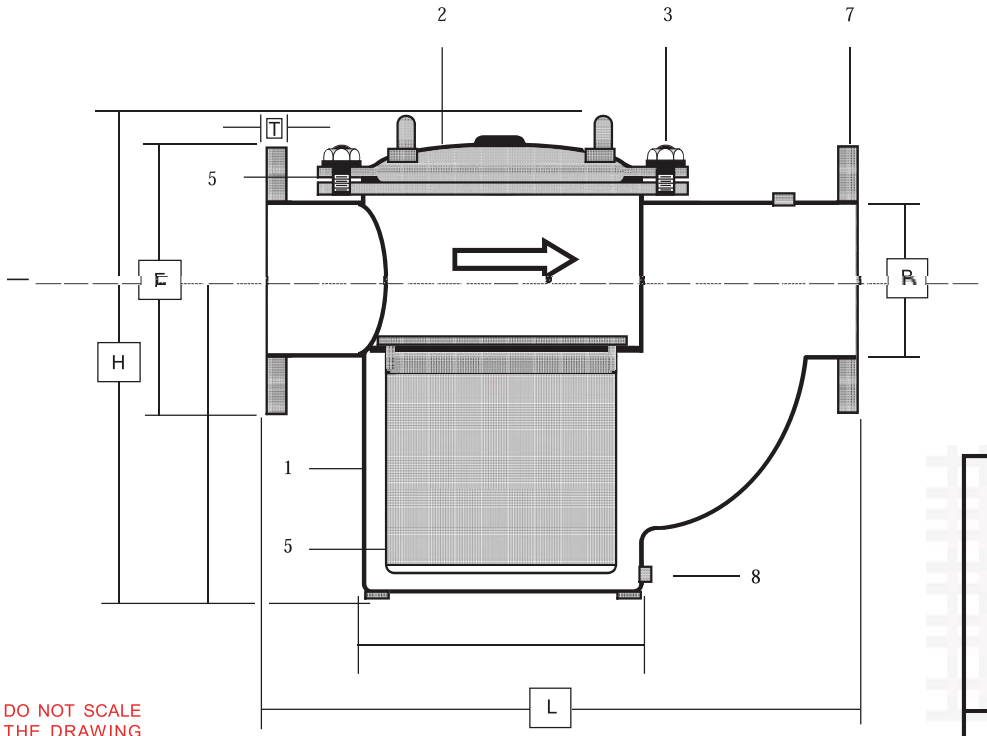
TESTING OF POT STRAINER AS PER
BS - 6755 : PART-1
Hydro Testing Only
SHELL
225 PSIG 16 BAR

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

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

Dimensional Tolerance ± 5-7mm



DO NOT SCALE THE DRAWING

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 24G 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.

Pot Strainer

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.

DATE : 22.04.2021

Drg. No : SI/PN-16

Pot Strainer

Series : SI/PN-16/40-600

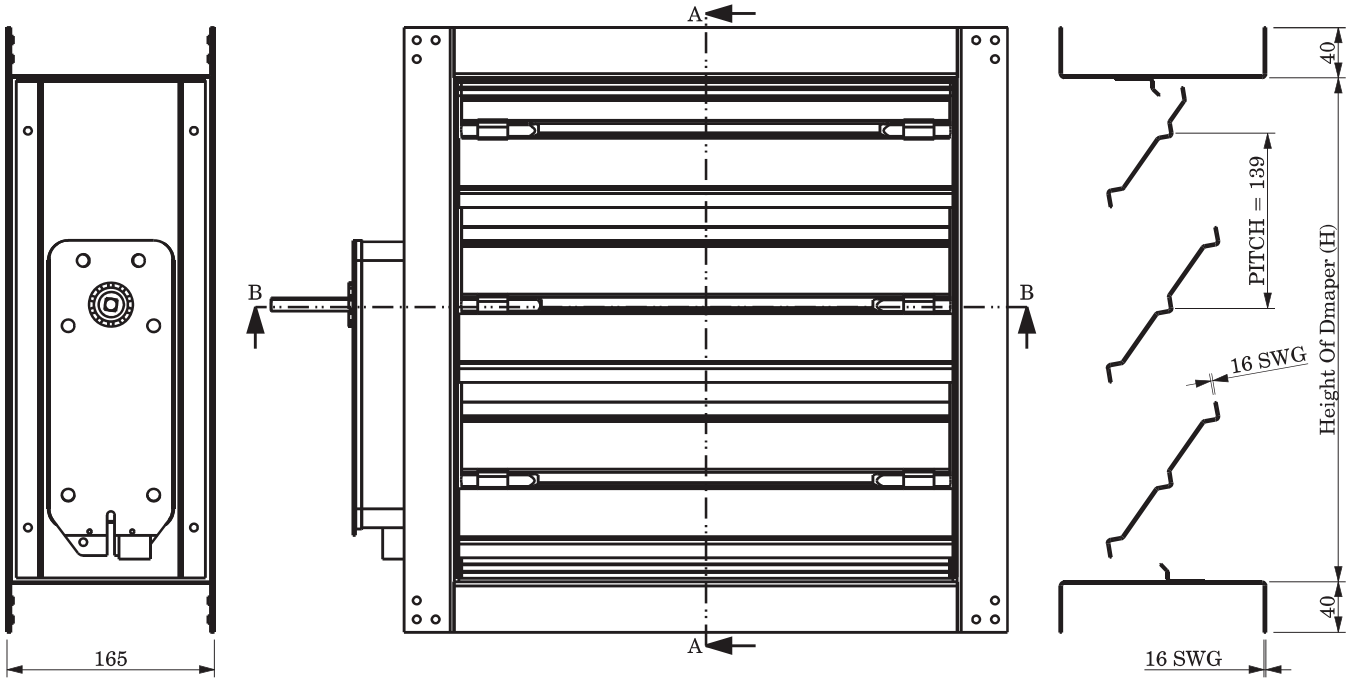
APPLICABLE FOR
ANNEXURE-I, ITEM NO. C3

Sr. No.	Description	Details
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	**Single Phase Actuator**	
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

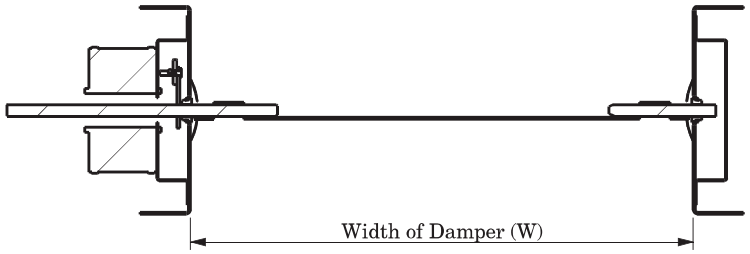
21.9	Degree Of Protection	IP 54
22	**Running Time**	
22.1	Motor	75 Seconds
22.2	Spring Return	20 Seconds
23	**Sound Level**	
23.1	Motor	45 Db(max.)
23.2	Spring Return	62 Db(max.)
24	Auxiliary Contacts	Limit Switches For Open & Close Position
24	Mode Of Control	Open - Actuator Energized
		Close- Actuator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

UNLESS OTHERWISE SPECIFIED ALL DIMENSION ARE IN m.m.

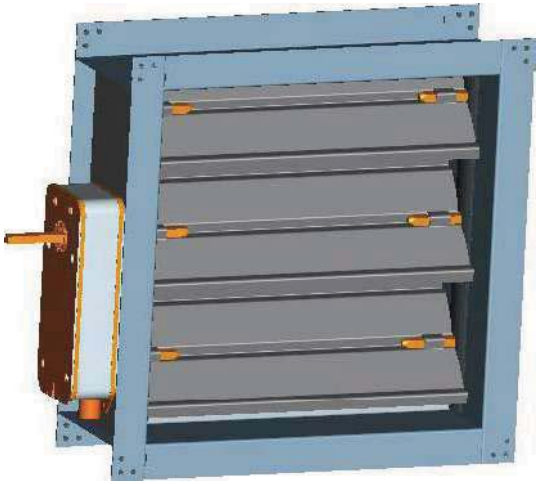
REV NO.	DATE	REVISION	REV. BY



SECTION A-A



SECTION B-B



PART DESCRIPTION:	REMOVE SHARP EDGES	DRAWING No.:	REV NO.:
WGD - WITHOUT SLEEVE - MOTORIZED	DATE: 13-Nov-2018	SIPL/ADP/GA/2604	00

MATERIAL:	M. STANDARD:	SCALE:	DRN. BY:	CHKD. BY:	APPD. BY:
-	-	N.T.S.	AMIR	DALIP	A.BHARDWAJ

MASS PROPERTIES:	
VOLUME (mm³)	-
WEIGHT (kg)	-
No. of SC/CC	
SC	-
CC	0

TOLERANCE LIMIT UNLESS SPECIFIED	
0.5 - 6 = ±0.3	>120 - 400 = ±2.0
>6 - 30 = ±0.5	>400 - 1000 = ±3.0
>30 - 120 = ±0.8	>1000 - 2000 = ±4.0

systemair

SYSTEMAIR INDIA PVT.LTD.

FILE PATH: Y:\Plants\Greater_Noida\CAD_Team\Amir Ansari\2. ADP\GA DRAWINGS\WGD-WITHOUT SLEEVE-MOTORIZED

BELIMO

Technical data sheet NFA-S2

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 m²**
- **Torque 10 Nm**
- **Nominal voltage AC 24 ... 240 V / DC 24 ... 125 V**
- **Control: Open-close**
- **Two integrated auxiliary switches**

Technical data

Electrical data	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 ⧈ (1 x fix 10% / 1 x adjustable 10 ... 90%)
	Connection	Motor	Cable 1 m, 2 x 0.75 mm²
		Auxiliary switch	Cable 1 m, 6 x 0.75 mm²
Functional data	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
Safety	Protection class		**II** Totally insulated ⧈
	Degree of protection		IP54 NEMA2, UL Enclosure Type 2
	EMC Low-voltage directive		CE according to 2004/108/EC 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
Dimensions / Weight	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

Mode of operation
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.

Simple direct mounting
Simple direct mounting on the damper spindle with a universal spindle clamp, supplied with an anti-rotation strap to prevent the actuator from rotating.

Manual override
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.

Adjustable angle of rotation
Adjustable angle of rotation with mechanical end stop.

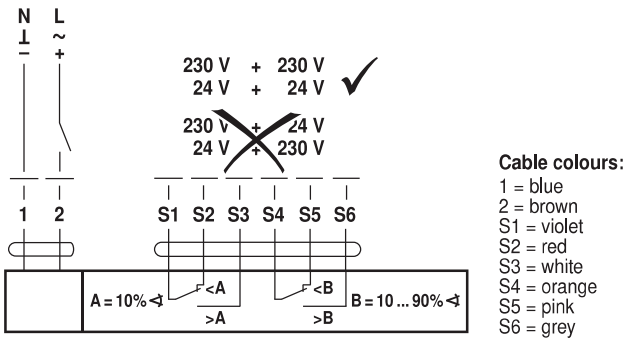
High operational reliability
The actuator is overload-proof, requires no limit switches and automatically stops when the end stop is reached.

Flexible signalization
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

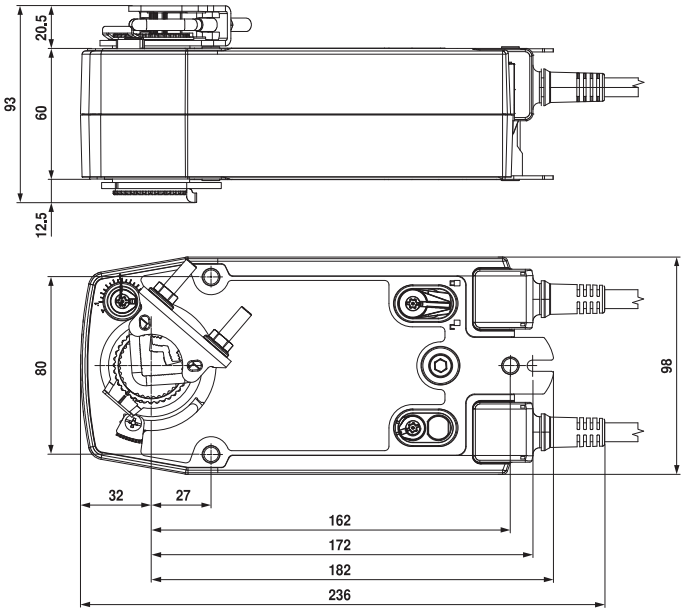
Accessories

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

* further versions on request

Dimensions [mm]

Dimensional drawings



Variant 1a:
¾"-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

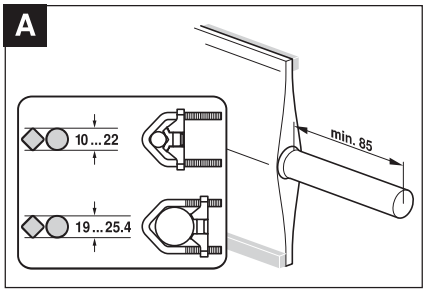
Damper spindle	Length	⌀	□
	≥85	19 ... 25.4 (26.7)	12 ... 18
	≥15		

Variant 2:
½"-spindle clamp (optional via configuration)

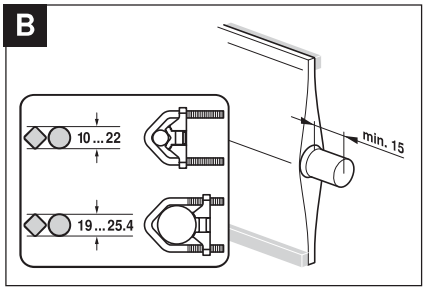
Damper spindle	Length	⌀	◇
	≥85	10 ... 19	14 ... 20
	≥15		

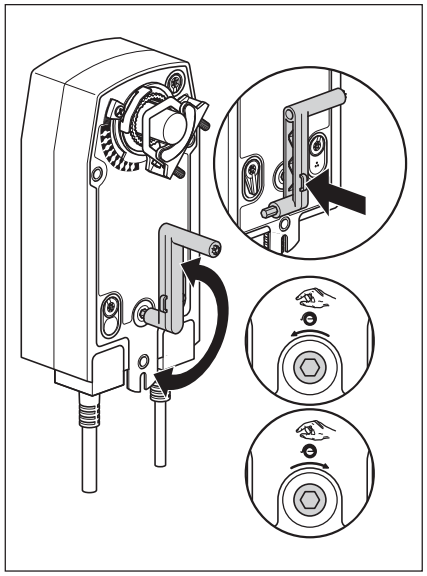
71127-00001.F

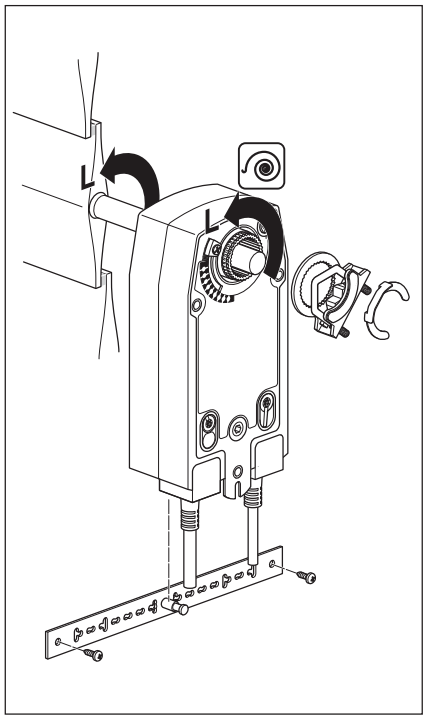
A

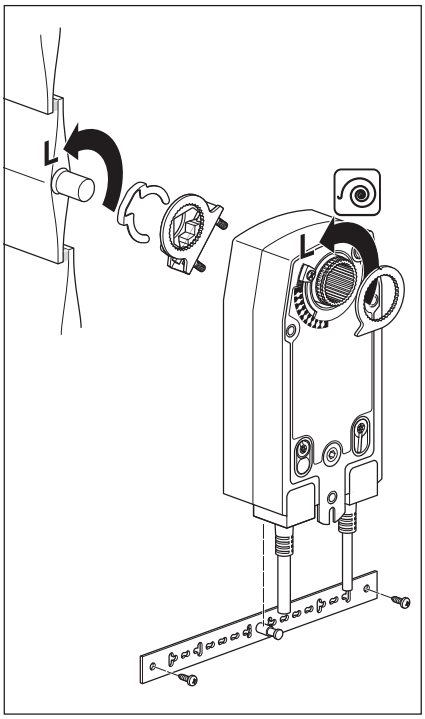


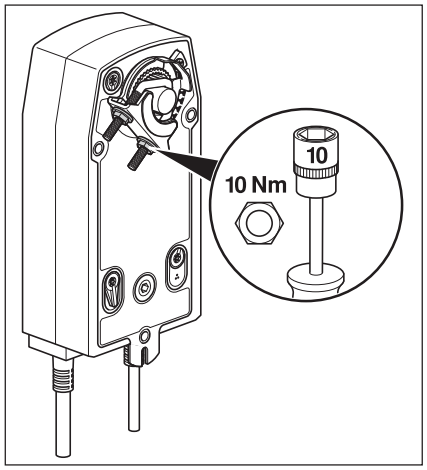
B

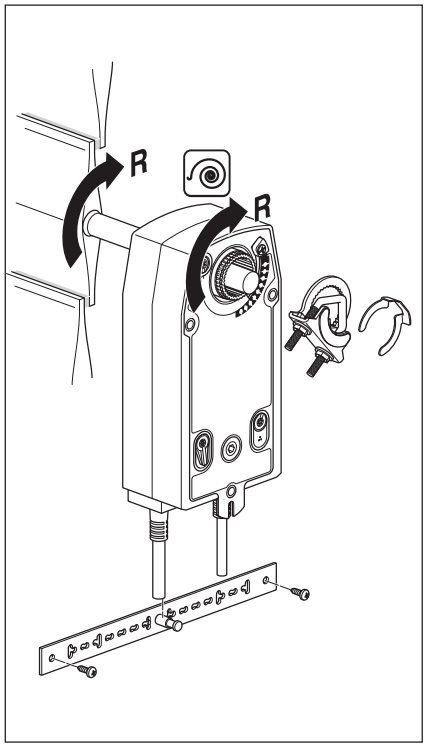


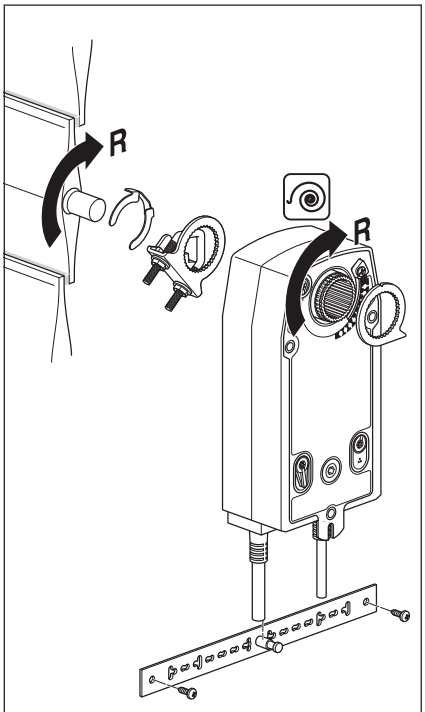


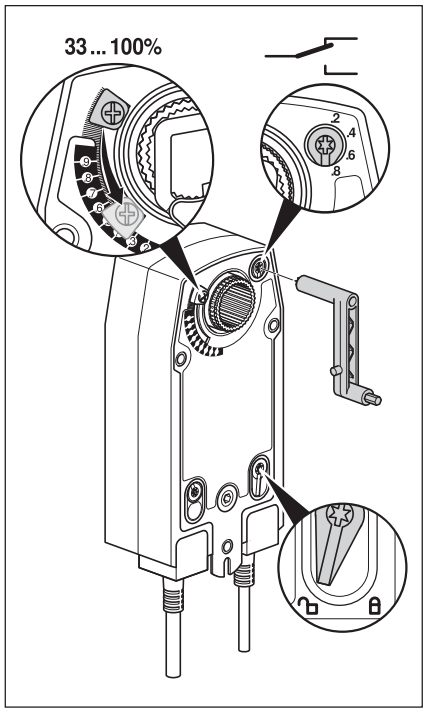




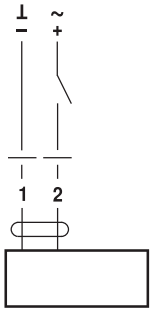




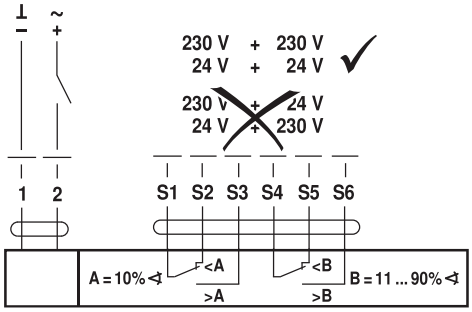




AC 24 V / DC 24 V

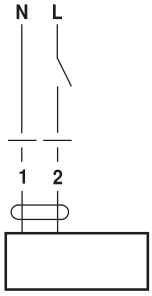


NF24A
SF24A

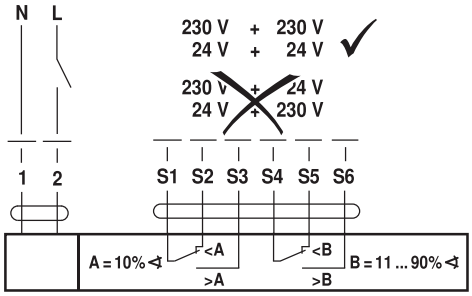


NF24A-S2
SF24A-S2

AC 230 V ⚠

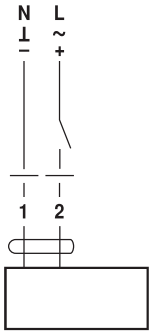


NF230A
SF230A

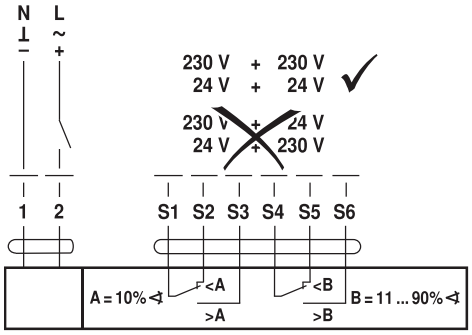


NF230A-S2
SF230A-S2

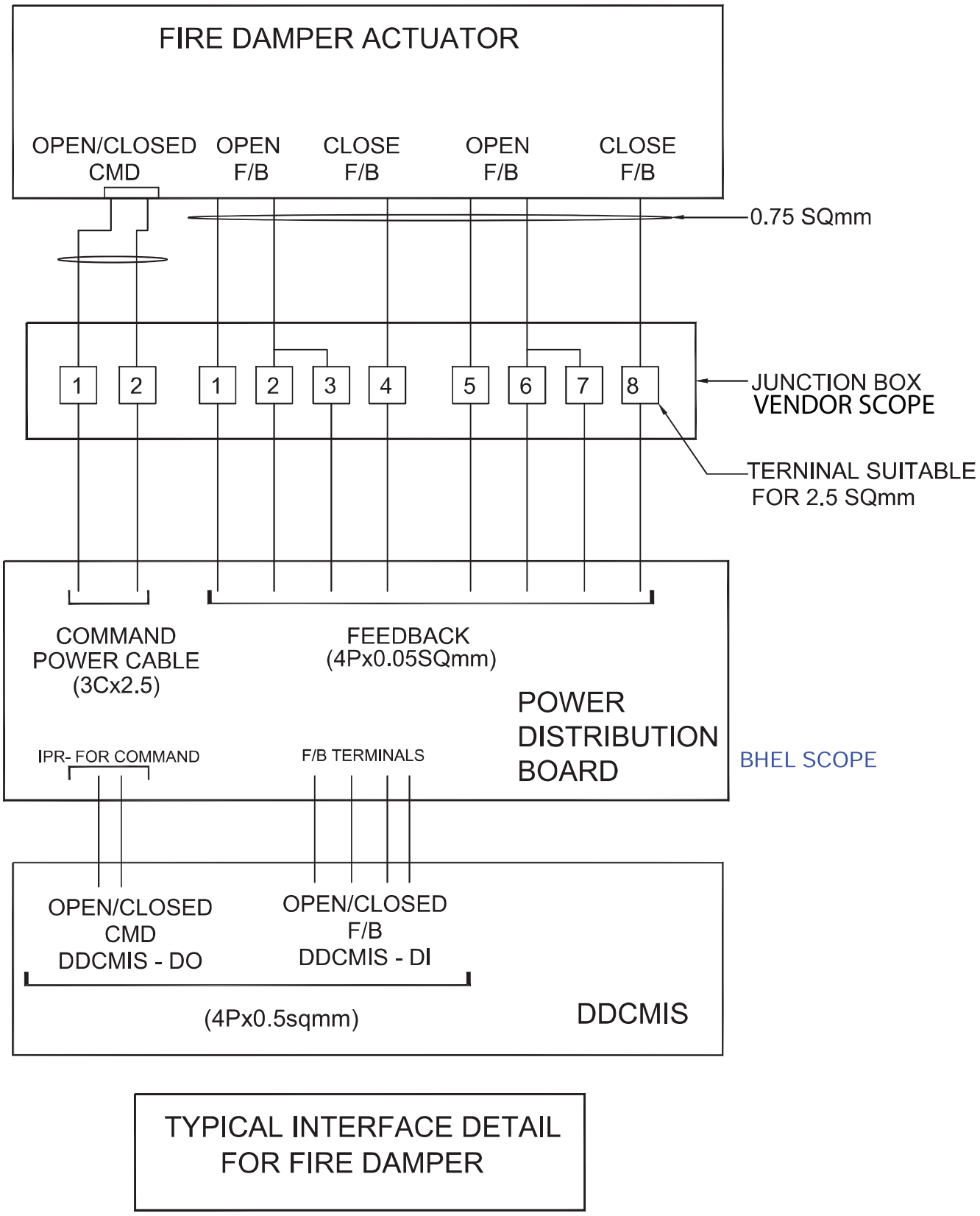
AC 24 ... 240 V / DC 24 ... 125 V ⚠



NFA
SFA



NFA-S2
SFA-S2



TYPICAL INTERFACE DETAIL
FOR FIRE DAMPER

APPLICABLE FOR ANNEXURE-I, ITEM NO. C1.1, 1.2, 1.3, 1.4, 1.5

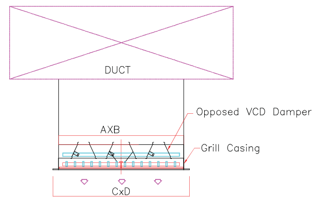
AxB=Neck size of Diffuser/Grille
where, A is Neck width of Diffuser/Grille
B is Neck depth of Diffuser/Grille

CxD=Overall size of Grille/Diffuser
Where, C is Overall Width of Diffuser/Grille
D is Overall Depth of Diffuser/Grille

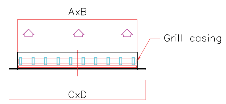
NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. THE SURFACE SOUND PRESSURE LEVEL AT A DISTANCE OF 1 M FROM EACH GRILLE/DIFFUSER SHALL BE MAXIMUM 45 DB(A) .
3. PRESSURE DROP IN GRILLE/DIFFUSER SHALL BE 2.5mmWG (MAX.).
4. THE DIFFUSER/GRILLE SHALL BE EXTRUDED ALUMINIUM OF MINIMUM 2mm thk
5. ALL DUCTING SURFACE COMING IN CONTACT WITH CORROSIVE FUMES OR GASES SHALL BE PAINTED WITH THREE COATS OF EPOXY PAINT OVER A COAT OF SUITABLE PRIMER.

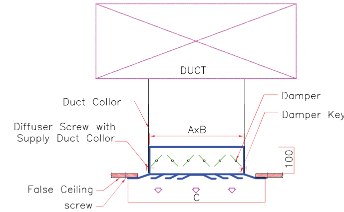
Noise level within the air conditional space shall be restricted to 35-45 NC level with suitable acoustic attenuation/ duct silencers/ acoustic insulation, etc.



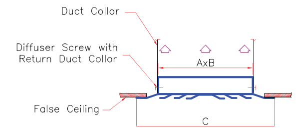
SIDE VIEW



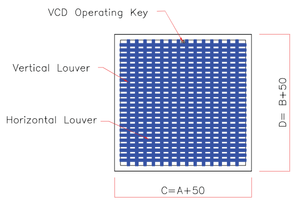
SIDE VIEW



SIDE VIEW

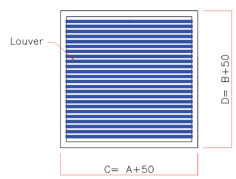


SIDE VIEW



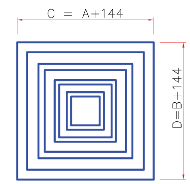
FRONT VIEW

SUPPLY AIR GRILLE



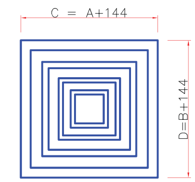
FRONT VIEW

RETURN AIR GRILLE



FRONT VIEW

SUPPLY AIR DIFFUSER



FRONT VIEW

RETURN AIR DIFFUSER

SCHEDULE FOR GRILL SIZE

SR. NO	AXB	GRILL SIZE CXC	FACE AREA SQ.M EACH
01.	350X350	400X400	0.1600
02.	375X375	425X425	0.1806
03.	450X450	500X500	0.2500
01.	500X500	550X550	0.3025
02.	550X550	600X600	0.3600
03.	600X600	650X650	0.4225

SCHEDULE FOR DIFFUSER SIZE

SR. NO	AXB (NECK SIZE)	DIFFUSER SIZE CXC	FACE AREA SQ.M EACH
01.	300X300	450X450	0.2025
02.	375X375	520X520	0.2704
03.	450X450	595X595	0.3540

SUPPLY AIR GRILL SPECIFICATION :-

S.NO	DESCRIPTION	SPECIFICATION
01.	FRAME	EXTRUDED ALUMINIUM
02.	BLADE	EXTRUDED ALUMINIUM
03.	TYPE	POWDER COATED, DOUBLE LOUVERS, DOUBLE DEFLECTION WITH VOLUME CONTROL DAMPER COLOUR POWDER COATING MATCHES WITH INTERIOR DECOR.
04.	MOC	DAMPER– 20G, GI, LOUVERS – 22G, GI
05.	DAMPER OPERATION	FRONT OPERATED & KEY CONCEALED
06.	MAKE	AS PER MAIN CONTRACTOR APPROVED MAKE LIST

RETURN AIR GRILL SPECIFICATION :-

S.NO	DESCRIPTION	SPECIFICATION
01.	FRAME	EXTRUDED ALUMINIUM
02.	BLADE	EXTRUDED ALUMINIUM
03.	TYPE	POWDER COATED, SINGLE LOUVERS SINGLE DEFLECTION
04.	MOC	DAMPER– 20G, GI, LOUVERS – 22G, GI
05.	MAKE	AS PER MAIN CONTRACTOR APPROVED MAKE LIST

SUPPLY AIR DIFFUSER SPECIFICATION :-

Damper 20G GI
Louvers 22 G GI

S.NO	DESCRIPTION	SPECIFICATION
01.	FRAME	EXTRUDED ALUMINIUM
02.	TYPE	SQUARE DIFFUSER WITH VOLUME CONTROL DAMPER
03.	FINISH	POWDER COATED
04.	MAKE	AS PER MAIN CONTRACTOR APPROVED MAKE LIST

RETURN AIR DIFFUSER SPECIFICATION :-

Damper 20G GI
Louvers 22 G GI

S.NO	DESCRIPTION	SPECIFICATION
01.	FRAME	EXTRUDED ALUMINIUM
02.	TYPE	SQUARE DIFFUSER
03.	FINISH	POWDER COATED TO MATCH INTERIOR DECOR
04.	MAKE	AS PER MAIN CONTRACTOR APPROVED MAKE LIST

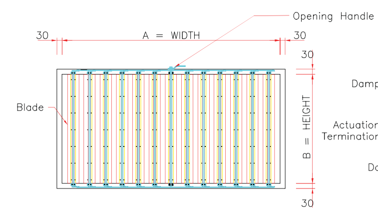
VOLUME CONTROL DAMPER DETAIL :-

S.NO	DESCRIPTION	SPECIFICATION
01.	MANUFACTURER	AS PER MAIN CONTRACTOR APPROVED MAKE LIST
02.	DAMPER'S TYPE	BOX TYPE/ OPPOSED BLADE
03.	DAMPER'S CASING	20 G (MINIMUM)
04.	DAMPER BLADE	22 G (MINIMUM)
05.	MOC	GI
06.	OPERATION	MANUAL / MOTORISED
07.	ACTUATOR MAKE	AS PER MAIN CONTRACTOR APPROVED MAKE LIST

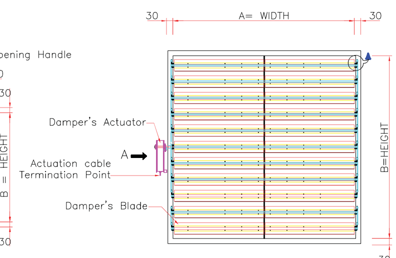
CONTINUOUS GRILL

SCHEDULE FOR CONTINUOUS GRILL

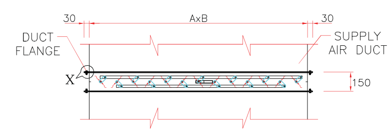
SR. NO	A	B
01.	150	AS PER REQUIREMENT
02.	200	AS PER REQUIREMENT
03.	300	AS PER REQUIREMENT



FRONT VIEW



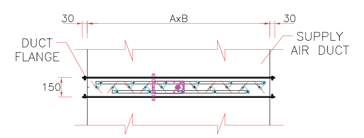
FRONT VIEW



TOP VIEW

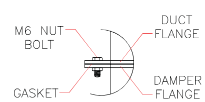
MANUAL VOLUME CONTROL DAMPER

(NOTE : A & B ARE AS PER DUCT SIZES.)



VIEW FROM SIDE–"A"

MOTORISED VOLUME CONTROL DAMPER



DETAIL–"X"

REV. NO.	DESCRIPTION	DATE	DRN	CHKD	APPD
00	FOR APPROVAL				

STAMP

JOB NO.	466
STATUS	CONTRACT
DISTRIBUTION	

REV.	DATE	ALTD	CHD	APPD

NTPC DWG. NO. 2100-109-PVM-Y-004B

CUSTOMER NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT 3 x 200+3X500+1X500 MW NTPC KORBA TPP - FGD

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
E	DRN			
	DESN			16.08.2021
	CHD			16.08.2021
	APPD			16.08.2021

TITLE GA OF SUPPLY/RETURN AIR DIFFUSER/GRILL FOR A/C & VENTILATION SYSTEM

DEPT. SIGN DATE SCALE

BHEL DRAWING NO. PE-V0-466-(571-13000-A)-A212

SHEET REV. 00 SIZE- A2

APPLICABLE FOR ANNEXURE-I, ITEM NO. A6.a

NTPC DOCUMENT NO.	DOCUMENT NAME	BHEL DOCUMENT NO.
2100-109-PVM-B-262	TDS AND GA OF PAC / SPLIT AIR CONDITIONER	PE-V0-466-(571-13000-A)-A213

Technical Specifications

Product Information	Product code	IA318DNU/ IA318DNUWK	IA324DNU/ IA324DNUWK
Performance Parameters	Product Series	DN	DN
	Norminal cooling capacity (TR)	1.5 TR	2.0 TR
	Air conditioner Type	Inverter split AC	Inverter split AC
	Star Rating - As Per bee	3-Star	3-Star
	Rated voltage/Frequency/Phase	230 V/ 50Hz/Single	230 V/ 50Hz/Single
	Rated cooling capacity (min-Max)(watt)	5050(1415~5472)	6350(1772~6624)
	Rated cooling capacity (min-Max) (BTU/HR)	17230(4828~18670)	21666(6046~2260)
	Rated cooling capacity (50% Load)(watt)	2525	3175
	Rated cooling capacity (min-Max)(watt)	1590(355~1733)	2025(404~2118)
	Cooling Power input (50% Load (watt)	610	770
	Iseer	3.93	3.9
	Electricity consumed in 1600 Hour (units/Year)	995.24	1261.37
	Norminal current (cooling in Amps) Runing current	7.2	9.17
	Air flow volume (wet CFM) (High/Medium/Low)	514/450/415	576/501/399
Compressor,Refrigerant & Ambient Opterations	Noise level indoor (High/Medium/Low)in Db(A)	48.5/45.5/39.1	46.8/43.7/37.7
	Moisturer removal (Litre/Hour)	1.2	2
	Compressor type	Inverter Rotary	Inverter Rotary
	Refrigerant(Eco- Friendly)	R-32	R-32
	Ambient Temperature range (cooling)degree C	Up to 52degree C	Up to 52degree C

NTPC DOCUMENT NO.	DOCUMENT NAME		BHEL DOCUMENT NO.
2100-109-PVM-B-262	TDS AND GA OF PAC / SPLIT AIR CONDITIONER		PE-V0-466-(571-13000-A)-A213
Product Information	**Product code**	**IA318DNU/ IA318DNUWK**	**IA324DNU/ IA324DNUWK**
User Interface - Remote	Remote	LCD Remote with display	LCD Remote with display
Product Dimension, weight & Input Power Supply	IDU net dimesion (w*H*D) mm	960X320X215	1110X335X215
	Input power suppy	Indoor Unit	Indoor Unit
	Net weight IDU (In Kg)	12	15
	ODU net dimesion (w*H*D) mm	858X536X327	888.4X581.5X367
	Net weight ODU (In Kg)	25	31.5
	Noise level indoor in dB(A)	60	60
Tube Size & Piping Capcity	Suction tube size outer diameter inch (mm)	1/2"(12.7mm)	5/8"(15.88mm)
	Liquid tube size outer diameter inch (mm)	1/4"(6.35mm)	1/4"(6.35mm)
	Max piping capcity total (Metre)	15	15
	Max piping capcity vertical (Metre)	10	10
	Refrigerant additional charge beyond 5M (g/m)	15	15

APPLICABLE FOR ANNEXURE-I, ITEM NO.
A4, A5, B2 & C2

Customer	**NTPC**	**Job No.**	**M22/DEL-015.BHEL**
Project	**3X200+3X500+1x500 MW NTPC KORBA TPP-FGD**	**Date**	**11.12.2021**
BHEL Doc. No.	**PE-V0-466-(571-13000-A)-A214**		**----------**

Sr.No	Description	Unit	Details					
1	Surface	-	Supply and return air duct for AC system	Refrigerant (Suction & Liquid Line)	AHU Drain pipe	AHU Condensate pan (Insulation if required)	Acoustic insulation of duct	Exposed air duct
2	Make	-	Armacell /A Flex	Armacell /A Flex	Armacell /A Flex	U.P.Twiga / Lloyd	U.P.Twiga / Lloyd	U.P.Twiga / Lloyd
3	Material	-	Closed Cell Elastomeric Nitrile Rubber	Closed Cell Elastomeric Nitrile Rubber	Closed Cell Elastomeric Nitrile Rubber	Resin Bonded glass wool	Resin Bonded glass wool	Resin Bonded glass wool
4	Standard to follow	-	...	...	...	IS:8183	IS:8183	IS:8183
5	Insulation form	-	Sheet	Tube	Tube	Slab	Slab	Roll
6	Density	kg/ m3	40-60	40-60	40-60	24	48	24
7	Thickness	mm	19	19	19	25	25	50
8	Thermal Conductivity	w/m/deg C	0.036 at 20 °C	0.036 at 20 °C	0.036 at 20 °C	0.049 at 50 °C	0.043 at 50 °C	0.049 at 50 °C
9	Finish		As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard	Refer annexure-1)	F-4 (As per annexure-1)
10	Application details		Shall be as per approved Standard Drawing for Erection & Application Details of Insulation					
Note :			Insulation for HVAC application shall be CFC/HCFC free.					

Prep. By		Appr. By	Sheet 1 of 1

D:\Varsha\Adv\Format\Technical Parameter-Landscape..VA

ANNEXURE-1

1) **Finish F-4 (with Resin Bonded Glass Wool/Resin Bonded Mineral Wool)**

Step-1 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.

Step-2 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.

Step-3 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.

Step-4 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.

ACCOUSTIC INSULATION

a) All ducts up to a distance of 5 meters from AHU shall be acoustically lined from inside with 25 mm thick resin bonded glass wool of 48 Kg/Cu.M. density and 30 gauge perforated aluminium sheet having 5 mm dia perforation at 8 to 10 mm centre-to-centre distance.

b) Fibre glass tissue sheet shall be applied over the outer surface of insulation before applying perforated aluminium sheet.

APPLICABLE FOR ANNEXURE-I, ITEM NO. C1.1

Customer	**NTPC**	**Job No.**	**M22/DEL-27.BHEL**
Project	**3X200+3X500+1x500 MW NTPC KORBA TPP-FGD**	**Date**	**13.08.2021**
BHEL Doc. No.	**PE-V0-466-(571-13000-A)-A215**	**PACKAGE**	**HVAC FOR FGD**

TDS – GI SHEET		
Sr. No.	**DESCRIPTION**	**SPECIFICATION**
1	Application	Low pressure air duct
2	Make	SAIL/TATA/JSW
3	Type	GI Sheet, Lock forming quality (LFQ)
4	Grade	Conforming to class 275 of IS : 277
5	Form factors	Conforming to IS : 655
6	Coating	275 GSM
7	Shape	Rectangular
8	Flange type	TDF / TDC, as applicable
9	Gauge wise thickness	0 to 750 mm – 24 G
		751 to 1500 mm – 22 G
		1501 to 2250 mm – 20 G
		2251 to above – 18 G

Name of Project	3X200+3X500+1x500 MW NTPC KORBA TPP-FGD
Package	HVAC FOR FGD
Document Title	TECHNICAL DATASHEET OF PIPE FOR AC & VENTILATION SYSTEM
Document No.	**NTPC:2100-109-PVM-Y-005C,BHEL:PE-V0-466-(571-13000-A)-A217**

Sl. No.	DESCRIPTION	SPECIFICATION		
1	Make	Jindal		
2	Material	MS Black		
3	Conforming To	UAF Water Piping – Heavy grade IS : 1239 up to 150 NB & IS 3589 beyond 200 NB Header & Drain/Overflow Pipe Heavy grade IS : 1239 up to 150 NB & IS 3589 beyond 200 and galvanized as per IS 4736 Refrigerant Pipe Seamless steel tubes conforming heavy grade IS:1239 or Copper tubes as per IS: 2501 (copper material as per IS: 191 hard copper grade) Fittings 1) The steel Fitting shall conform to ASTM A234 Gr. WPB and Dimensional Standard to ANSI B 16.9/ANSI B 16.11 / equivalent for sizes 65 NB and above. 2) For sizes 50 NB and below, the material shall conform to ASTM A-105. 3) All Steel flanges shall be of slip on type and shall conform to ANSI B 16.5. 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. 5) Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B 31.5.		
4	Thickness	Nominal Pipe (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
		Below 150 NB	Refer attached document Heavy Grade as per IS: 1239	
5	Density of pipe	7850 Kg/m^3		
6	Pipe Sizes	As per approved P & ID		

Name of Project	3X200+3X500+1x500 MW NTPC KORBA TPP-FGD
Package	HVAC FOR FGD
Document Title	TECHNICAL DATASHEET OF PIPE FOR AC & VENTILATION SYSTEM
Document No.	**NTPC:2100-109-PVM-Y-005C,BHEL:PE-V0-466-(571-13000-A)-A217**

7	Quantity	As per System requirement
8	Hydrostatic Pressure	As per standard IS:1239/3589 – Hydrostatic test Pressure will be 5 MPa
9	Max. working Pressure	4.5 Kg/sq. cm
10	Design Pressure	1.5 times the working pressure
11	Painting Details	As per Technical specification
12	Random Length of Pipe	Approx. 6 Mtr.
13	Pipe end details	Bevel end for 65 NB and above Plain end for sizes 50 NB and below. Drain/ Overflow Pipe - Screwed
14.	Copper Pipe for Condensing Unit	Min. L grade for both liquid and Gas line

Table 4 Dimensions and Nominal Mass of Steel Tubes — Medium

(*Clause* 8.1)

Nominal Bore	Outside Diameter		Thickness	Mass of Tube	
	Maximum	Minimum		Plain End	Screwed and Socketed
mm	mm	mm	mm	kg/m	kg/m
(1)	(2)	(3)	(4)	(5)	(6)
6	10 6	9 8	2 0	0 404	0 407
8	14 0	13 2	2 3	0 641	0 645
10	17 5	16 7	2 3	0 839	0 845
15	21 8	21 0	2 6	1 21	1 22
20	27 3	26 5	2 6	1 56	1 57
25	34 2	33 3	3 2	2 41	2 43
32	42 9	42 0	3 2	3 10	3 13
40	48 8	47 9	3 2	3 56	3 60
50	60 8	59 7	3 6	5 03	5 10
65	76 6	75 3	3 6	6 42	6 54
80	89 5	88 0	4 0	8 36	8 53
100	115 0	113 1	4 5	12 2	12 5
125	140 8	138 5	4 8	15 9	16 4
150	166 5	163 9	4 8	18 9	19 5

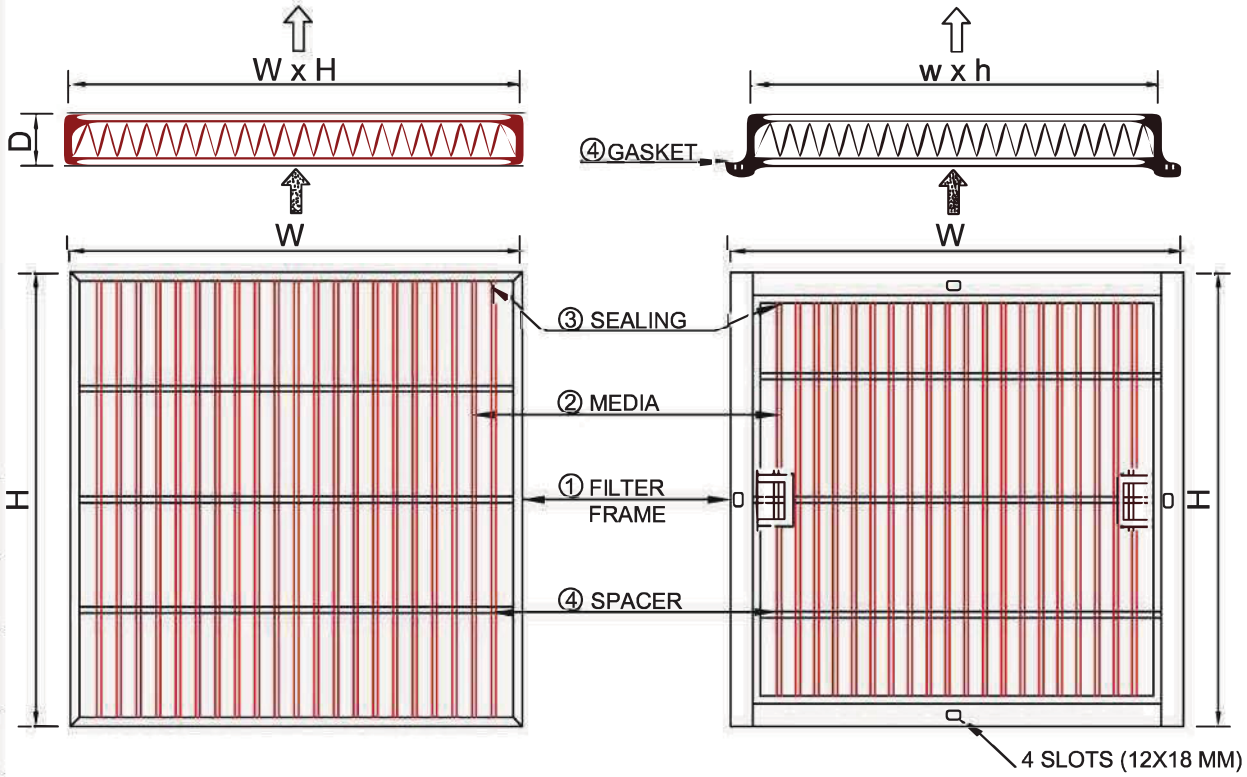
Table 5 Dimensions and Nominal Mass of Steel Tubes — Heavy

(*Clause* 8.1)

Nominal Bore	Outside Diameter		Thickness	Mass of Tube	
	Maximum	Minimum		Plain End	Screwed and Socketed
mm	mm	mm	mm	kg/m	kg/m
(1)	(2)	(3)	(4)	(5)	(6)
6	10 5	9 8	2 6	0 487	0 490
8	14 0	13 2	2 9	0 765	0 769
10	17 5	16 7	2 9	1 02	1 03
15	21 8	21 0	3 2	1 44	1 45
20	27 3	26 5	3 2	1 87	1 88
25	34 2	33 3	4 0	2 93	2 95
32	42 9	42 0	4 0	3 79	3 82
40	48 8	47 9	4 0	4 37	4 41
50	60 8	59 7	4 5	6 19	6 26
65	76 6	75 3	4 5	7 93	8 05
80	89 5	88 0	4 8	9 90	10 1
100	115 0	113 1	5 4	14 5	14 8
125	140 8	138 5	5 4	17 9	18 4
150	166 5	163 9	5 4	21 3	21 9

TECHNICAL DATA SHEET FOR PRE FILTERS		
1	Make	As per approved vendor list
2	Application (Location)	Suction of AHU, Fresh Air Fan Discharge, Supply Air Fan Discharge
3	Frame type	Cassette (Box)/ Flange
4	Size	610x610x50mm Deep/ 610x305x50mm Deep
5	Qty (Nos)	As per Approved Drawing
6	Maximum Face velocity	2.5 m/sec
7	Rated Air Flow (CMH/CFM)	3350/1971
8	Initial pressure drop	≤ 5 mm of WC
9	Final pressure drop	Up to 7.5 mm of WC
10	Average synthetic dust wt. arrestance	65% to 80% As per BS:6540/ASHRAE-52-76/EN779
11	Frame material	GI sheet 18 G (1.29 ± 0.12mm) as per IS 277
12	Filter Media	Washable non-woven synthetic Fibre or high density polyethylene (HDPE) media. (Washable & fire retardant and resistant to moisture, fungi, bacteria & frost) with HDPE mesh on air entry side & Al expanded mesh on air exit side
13	Filter Media Basic Weight/ Thickness	120 ± 10% GSM / > 4 mm
14	Media sealing	Epoxy
16	Spacers	Al sheet 20 G (0.91 ± 0.08 mm) as per IS 737
17	Aesthetics	Clean external surface, No adhesive on frame
18	Filter cleaning	By compressed air/ water
19	Inspection & Testing	As per approved QAP
20	Filter Sealing	Neoprene sponge rubber sealing shall be provided on either face of the filter frame

PRE FILTER(BOX TYPE / FLANGE TYPE)



BILL OF MATERIAL

S.No	ITEM	MATERIAL	QTY	REMARKS
1	FILTER FRAME	GI Sheet 18 GAUGE	01 Nos	
2	FILTER MEDIA	HDPE WIRE MESH	01 Set	*As per Detail
3	SEALING	EPOXY	01 Set	
4	SPACER	AL 20 GAUGE	03 Nos	
5	GASKET	Neoprene Sponge Rubber	01 Set	Flange type only

NOTE:-

FILTER MEDIA : Thickness 4.0-5.0 mm Basic
Weight -100± 10% GSM
FILTER MEDIA No of Folds:-11 ±1/RFT
Sheet Thickness: GI sheet 18 G (1.25 ± 0.12 mm)
AlSheet 20 G-0.91 ± 0.08 mm

DIMENSIONS FOR BOX TYPE

S. No.	H +0/-3	W +0/-3	D ± 2
1	610	610	50
2	610	305	50
3	305	610	50

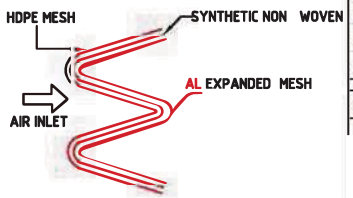
DIMENSIONS FOR FLANGE TYPE

S.	H/h +0/-3	W/w +0/-3	D ± 2
1	610	610	50
	550	550	
2	305	610	50
	245	550	
3	610	305	50
	550	245	

NOTE:-

REVISION DETAILS

REV NO.	REV DATE	COMMENTS



* FILTER MEDIA DETAIL

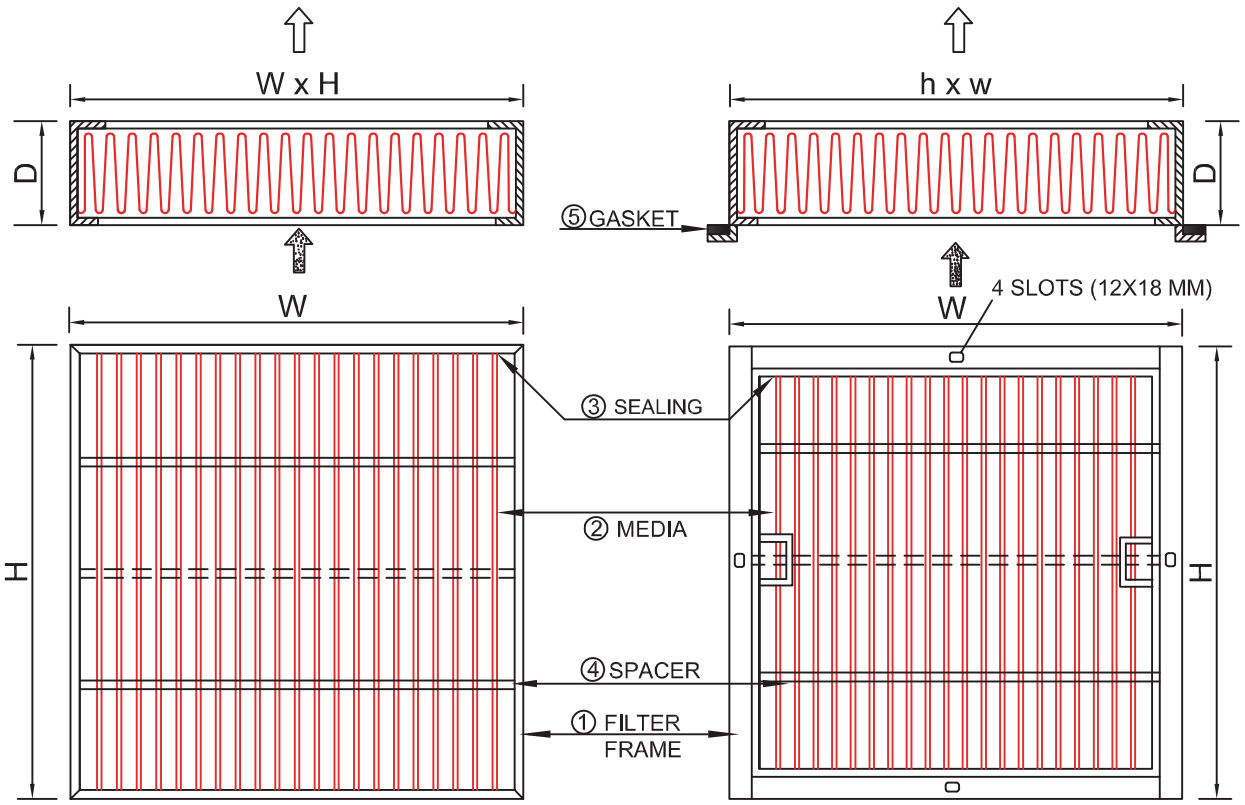
DWG TITLE:- PRE FILTER BOX / FLANGE TYPE

PROJECT : 3X200+3X500+1x500 MW NTPC KORBA TPP-FGD
Customer: NTPC Limited
EPC Contractor: BHEL
Contractor: Advance Ventilation Pvt Ltd.

APPLICABLE FOR ANNEXURE-I, ITEM NO. B4 (AXIAL FAN FILTERS)

TECHNICAL DATA SHEET FOR FINE FILTERS		
1	Make	As per approved vendor list
2	Application (Location)	AHU Discharge, Fresh Air Fan Discharge, Supply Air Fan Discharge
3	Frame type	Cassette (Box)/ Flange
4	Size	610x610x300mm Deep/ 610x305x300mm Deep
5	Qty (Nos)	As per Approved Drawing
6	Maximum Face velocity	2.4 m/sec
7	Rated Air Flow (CMH/CFM)	3200/1883
8	Initial pressure drop	≤ 10 mm of WC
9	Final pressure drop	25 mm of WC
10	Average synthetic dust wt. arrestance	>90% As per BS:6540/ASHRAE-52-76/EN779
11	Frame material	GI sheet 18 G (1.29 ± 0.12mm) as per IS 277
12	Spacers	Al sheet 20 G (0.91 ± 0.08 mm) as per IS 737
13	Filter Media	Washable non-woven synthetic Fibre or high density polyethylene (HDPE) media. (Washable & fire retardant and resistant to moisture, fungi, bacteria & frost) with HDPE mesh on air entry side & Al expanded mesh on air exit side
14	Filter Media Basic Weight/ Thickness	200 ± 10% GSM / > 1.5 mm
15	Media sealing	Epoxy
16	Aesthetics	Clean external surface, No adhesive on frame
17	Filter cleaning	By compressed air/ water
18	Inspection & Testing	As per approved QAP
19	Filter Sealing	Neoprene sponge rubber sealing shall be provided on either face of the filter frame

FINE FILTER BOX / FLANGE TYPE



BILL OF MATERIAL

S.No	ITEM	MATERIAL	QTY	REMARKS
1	FILTER FRAME	G I Sheet 18G	01 Nos	
2	FILTER MEDIA	HDPE WIRE MESH	01 Set	*As per Detail
3	SEALING	EPOXY	01 Set	
4	SPACER	AL.20 GAUGE	03 Nos	
5	GASKET	Neoprene sponge rubber	01 Nos	Flange type only

NOTE:-

FILTER MEDIA : Thickness 1.5-1.6 mm
Basic Weight -165± 5% GSM
FILTER MEDIA No of Pleats:-11 ±1/RFT
Sheet Thickness: GI sheet 18 G -1.29 ± 0.12 mm
AlSheet 20 G-0.91 ± 0.08 mm

DIMENSIONS FOR BOX TYPE

S. No.	H +0/-3	W +0/-3	D ± 2
1	610	610	300
2	610	305	300
3	305	610	300

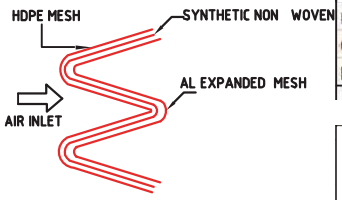
DIMENSIONS FOR FLANGE TYPE

S. No.	H/h +0/-3	W/w +0/-3	D ± 2
1	610	610	300
	550	550	
2	305	610	300
	245	550	
3	610	305	300
	550	245	

NOTE:-

REVISION DETAILS

REV NO.	REV DATE	COMMENTS



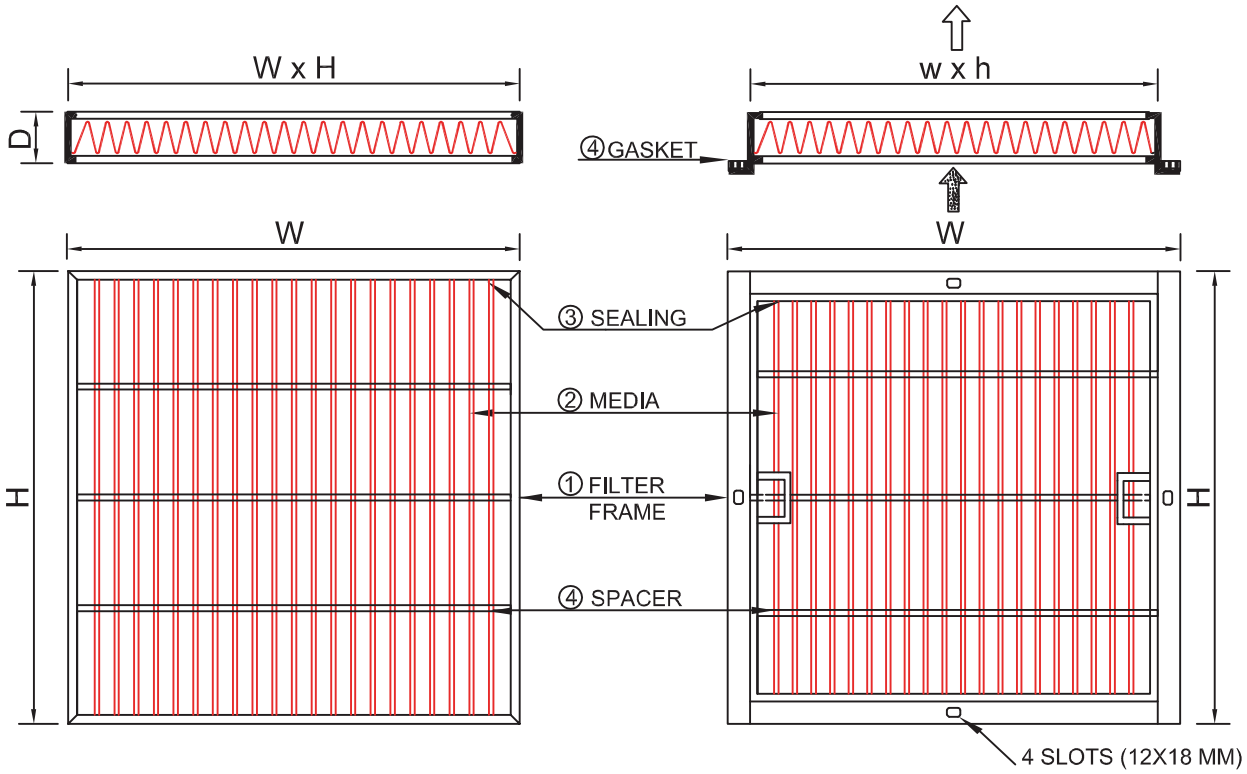
* FILTER MEDIA DETAIL

DWG TITLE:- PRE FILTER BOX / FLANGE TYPE
PROJECT : 3X200+3X500+1x500 MW NTPC KORBA TPP-FGD
Customer: NTPC Limited
EPC Contractor: BHEL

APPLICABLE FOR ANNEXURE-I, ITEM NO. B1a, B1b & B1c (UAF FILTERS)

TECHNICAL DATA SHEET FOR WATER REPELLANT FILTERS		
1	Make	As per approved vendor list
2	Application (Location)	Unitary Air Filteration (UAF Unit)
3	Frame type	Cassette (Box)/ Flange
4	Size	610x610x50mm Deep/ 610x305x50mm Deep
5	Qty (Nos)	As per Approved Drawing
6	Maximum Face velocity	2.5 m/sec
7	Rated Air Flow (CMH/CFM)	3350/1971
8	Initial pressure drop	≤ 5 mm of WC at rated flow
9	Final pressure drop	Upto 7.5 mm of WC
10	Average synthetic dust wt. arrestance	65% to 80% As per BS:6540/ASHRAE-52-76/EN779
11	Frame material	GI sheet 18 G (1.29 ± 0.12mm) as per IS 277
12	Spacers	Al sheet 20 G (0.91 ± 0.08 mm) as per IS 737
13	Filter Media	Multiple layers of Nylon Mesh and supported by AL. Expanded mesh. (Water Repellent Type)
14	Media sealing	Epoxy
15	Aesthetics	Clean external surface, No adhesive on frame
16	Filter cleaning	By compressed air/ water
17	Filter Sealing	Neoprene sponge rubber sealing shall be provided on either face of the filter frame

PRE FILTER(BOX TYPE / FLANGE TYPE)



BILL OF MATERIAL

S.No	ITEM	MATERIAL	QTY	REMARKS
1	FILTER FRAME	GI Sheet 18G	01 Nos	
2	FILTER MEDIA	WATER REPELLENT NYLON TYPE	01 Set	*As per Detail
3	SEALING	EPOXY	01 Set	
4	SPACER	AL 20 GAUGE	03 Nos	
5	GASKET	Neoprene Rubber	01 Set	Flange type only

NOTE:-

FILTER MEDIA : Thickness 4.0-5.0 mm
Basic Weight -100± 10% GSM
FILTER MEDIA No of Folds:-11 ±1/RFT
Sheet Thickness: GI sheet 18 G -1.29 ± 0.12 mm
AlSheet 20 G-0.91 ± 0.08 mm

DIMENSIONS FOR BOX TYPE

S. No.	H +0/-3	W +0/-3	D ± 2
1	610	610	50
2	610	305	50
3	305	610	50

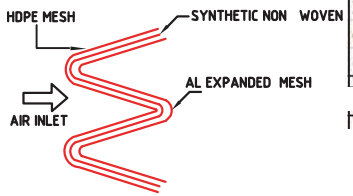
DIMENSIONS FOR FLANGE TYPE

S. No.	H/h +0/-3	W/w +0/-3	D ± 2
1	610	610	50
	550	550	
2	305	610	50
	245	550	
3	610	305	50
	550	245	

NOTE:-

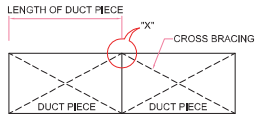
REVISION DETAILS

REV NO.	REV DATE	COMMENTS

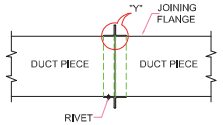


* FILTER MEDIA DETAIL

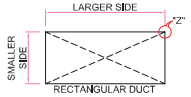
DWG TITLE:-
WATER REPELLENT FILTER BOX /FLANGE TYPE
PROJECT : 3X200+3X500+1x500 MW NTPC KORBA TPP-FGD
Customer: NTPC Limited
EPC Contractor: BHEL



DUCT JOINT (TYPE-A)

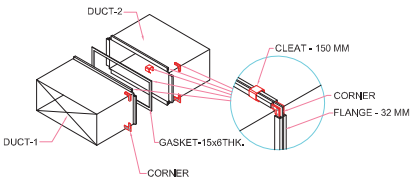


DUCT JOINT (TYPE-B)

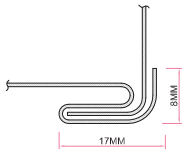


DUCT JOINT (CORNER DETAIL)
(FOR ALL DUCT)

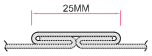
NOTE:-
ALL RECTANGULAR DUCT SHALL BE FLAT ON FACE AND DOUBLE SEAM JOINT (DETAIL-2) ON CORNER OF DUCT



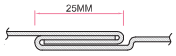
TYPICAL TDF JOINT DETAIL
FACTORY FABRICATED DUCTING



1J DOUBLE SEAM
DETAIL-Z

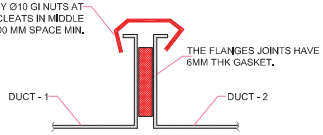


1D DRIVE SLIP
DETAIL-X



1A GROOVED SEAM
DETAIL-X

INTER CONNECTING FLANGES SHALL BE CONNECTED WITH EACH OTHER BY Ø10 GI NUTS AT CORNERS & BY CLEATS IN MIDDLE @ 300 MM SPACE MIN.



FLANGE JOINT
DETAIL-Y

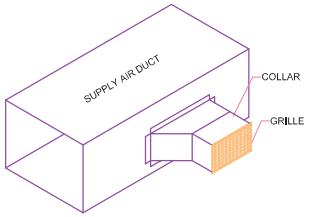
UP TO 300mm	NO CLEAT
UP TO 900mm	1 CLEAT
UP TO 1000mm	2 CLEAT
C/C DIS. BITWEEN 2 CLEAT 300mm	

NOTES:-

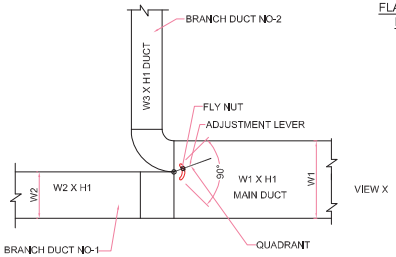
1. ALL RECTANGULAR DUCTS OVER 450 mm IN EITHER DIMENSION SHALL BE CROSS BROKEN. IT IS NOT NECESSARY TO HAVE CROSS BREAKING THE AIR OUTLET CONNECTION OF DUCT (COLLAR & DIFFUSERS) DEPENDING UPON THE LENGTH OF COLLAR/DIFFUSER.
2. ALL FLANGED JOINTS SHALL HAVE 6 MM THICK PACKING STUCK TO THE FLANGES.
3. ALL ANGLES USED FOR BRACING SHALL BE RIVETED AT ABOUT 150 MM CENTERS.
4. ALL TYPE OF DUCT JOINTS AND DUCT MATERIAL WITH THICKNESS AS PER IS:655.
5. DUCT SUPPORT TO BE TAKEN PREFERABLY FROM EXISTING STEEL AND RCC SLAB.
6. THE MS RODS FOR DUCTS ROUTED INSIDE THE BUILDING SHALL BE HUNG FROM THE EXISTING FLOOR BEAMS/WALL BEAMS / ROOF BEAMS/COLUMNS AS PROVIDED BY THE OWNER WITH PROVISION OF NECESSARY AUXILIARY OR SPECIAL STEEL MEMBERS OR BY HOOKS OR CAN BE PROVIDED BY CONTRACTOR BY DASH FASTENERS FIXED TO THE CEILING SLAB.
7. ALL THE PLENUM CHAMBERS OR CONNECTIONS TO FANS, DAMPERS ETC. SHALL BE CONSTRUCTED IN 16 GAUGE GSS, SUPPORTED ON 40X40X6 MM MS ANGLE FRAMES.

THICKNESS OF DUCT (GI)	
LARGER SIDE OF DUCT	THICKNESS
UPTO 750	24G (0.63mm)
751 TO 1000	22G (0.8mm)
1001 TO 1500	22G (0.8mm)
1501 TO 2250	20G (1.0mm)
2250 & LARGER	18G (1.25mm)

DETAIL OF DUCT SUPPORT		
LARGER SIDE OF DUCT	ANGLE	Ø D ROD (M.S)
UPTO 2250	L 40 X 40 X 6	10
ABOVE 2250	L 50 X 50 X 6	16



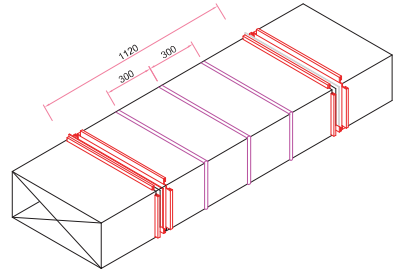
GRILLE FIXING DETAILS



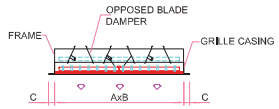
WHERE

(1) W1 = WIDTH OF THE MAIN DUCT.
(2) W2 = WIDTH OF BRANCH DUCT NO.-1
(3) W3 = WIDTH OF BRANCH DUCT NO.-2
(4) H1 = HEIGHT OF THE MAIN DUCT.
= HEIGHT OF BRANCH DUCT NO.-1
= HEIGHT OF BRANCH DUCT NO.-2
= 600
(5) W1 = W2 + W3

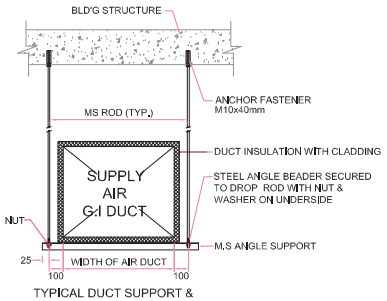
TYPICAL INSTALLATION ARRANGEMENT
OF SPLITTER DAMPER



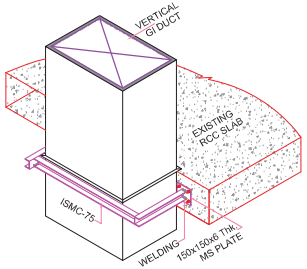
BRACING DETAIL BETWEEN TWO FLANGE



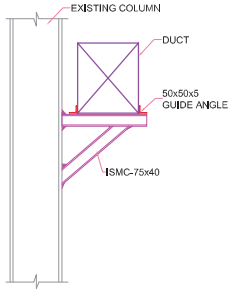
GRILLE WITH VCD
SIDE VIEW



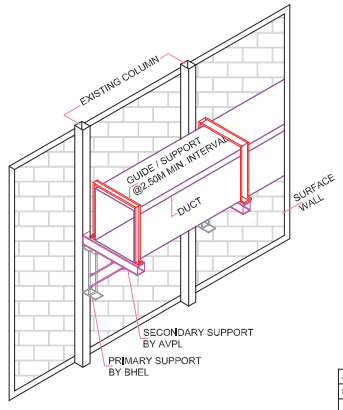
TYPICAL DUCT SUPPORT &
THERMAL INSULATION DETAILS



TYPICAL VERTICAL DUCT SUPPORT



DUCT SUPPORT FORM
BUILDING COLUMN



TYPICAL HORIZONTAL DUCTS SUPPORT

REV. NO.	DESCRIPTION	DATE	DRN.	CHKD	APPD
0	FOR APPROVAL	30.07.2021	JB	FJ	FJ

NTPC DOC NO: 2100-109-PVM-E-001

PROJECT: 3 x 200+3X500+1X500 MW NTPC KORBA TPP (FGD PKG)

OWNER: NTPC Limited

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA (U.P.)

JOB No. 466
STATUS PROJECT
CONTRACT
TO
No.OFF

REV	DATE	ALTD	CHD	APPD

DEPT.	NAME	SIGN	DATE
DRN			
DESN			
CHD			
APPD			

TITLE: STANDARD DRAWING FOR DUCT FABRICATION & SUPPORTING ARRANGEMENT AND ERECTION & APPLICATION DETAIL OF INSULATION

BHEL DOC.NO. PE-V0-466-(571-13000-A)-A306

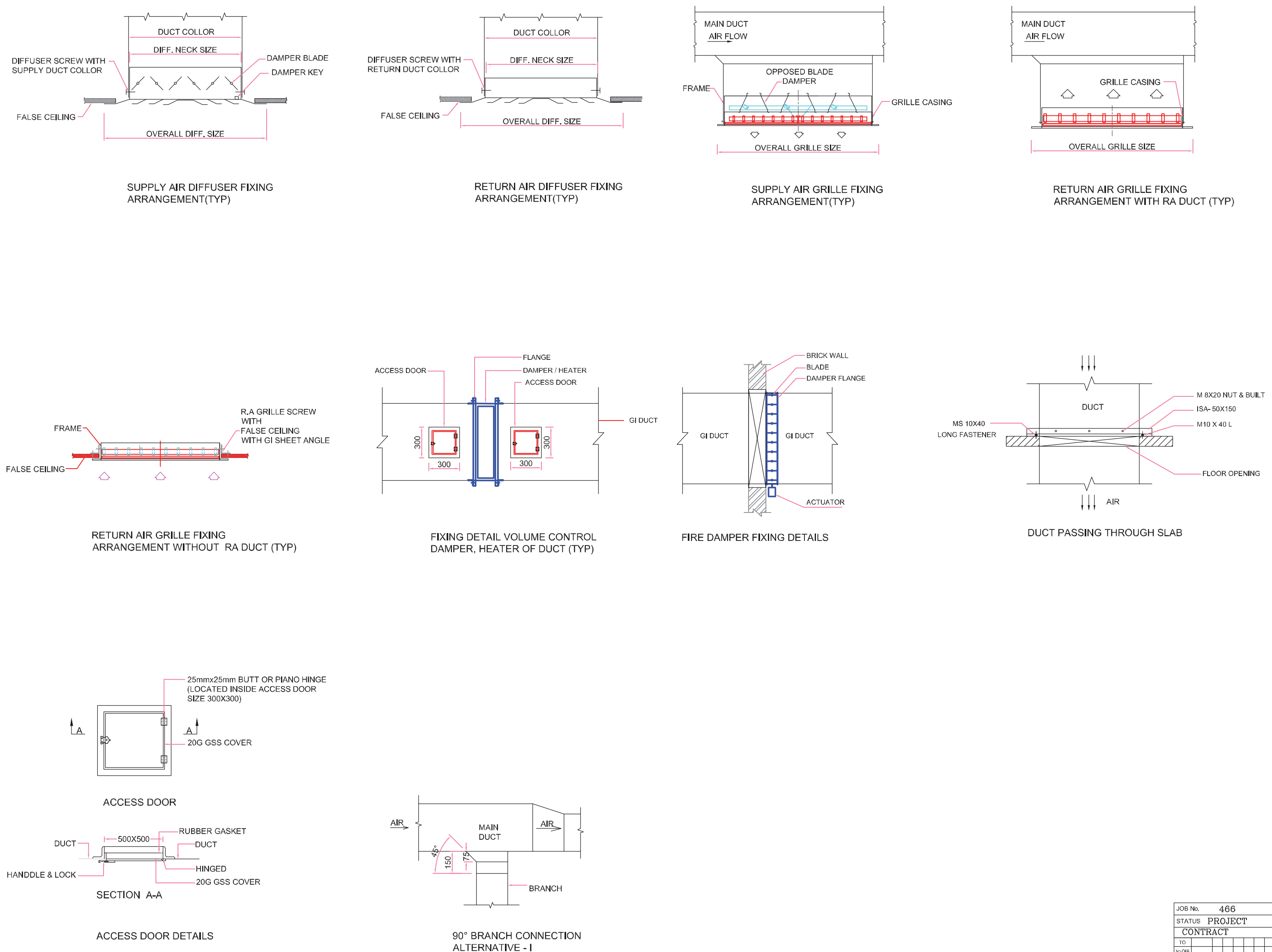
SHEET 1 OF 2 REV. 0

COMPUTER FILE NAME:

PE-V0-466-(571-13000-A)-A306

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



NOTES:-

1. ALL RECTANGULAR DUCTS OVER 450 mm IN EITHER DIMENSION SHALL BE CROSS BROKEN. IT IS NOT NECESSARY TO HAVE CROSS BREAKING THE AIR OUTLET CONNECTION OF DUCT (COLLAR & DIFFUSERS) DEPENDING UPON THE LENGTH OF COLLAR/DIFFUSER.
2. ALL FLANGED JOINTS SHALL HAVE 6 MM THICK PACKING STUCK TO THE FLANGES.
3. ALL ANGLES USED FOR BRACING SHALL BE RIVETED AT ABOUT 150 MM CENTERS.
4. ALL TYPE OF DUCT JOINTS AND DUCT MATERIAL WITH THICKNESS AS PER IS:655.
5. DUCT SUPPORT TO BE TAKEN PREFERABLY FROM EXISTING STEEL AND RCC SLAB.
6. THE MS RODS FOR DUCTS ROUTED INSIDE THE BUILDING SHALL BE HUNG FROM THE EXISTING FLOOR BEAMS/WALL BEAMS / ROOF BEAMS/COLUMNS AS PROVIDED BY THE OWN E R WITH PROVISION OF NECESSARY AUXILIARY OR SPECIAL STEEL MEMBERS OR BY HOOKS OR CAN BE PROVIDED BY CONTRACTOR BY DASH FASTENERS FIXED TO THE CEILING SLAB.
7. ALL THE PLENUM CHAMBERS OR CONNECTIONS TO FANS, DAMPERS ETC, SHALL BE CONSTRUCTED IN 18 GAUGE GSS, SUPPORTED ON 40X40X6 MM MS ANGLE FRAMES.

THICKNESS OF DUCT (G.I)

LARGER SIDE OF DUCT	THICKNESS
UPTO 750	24G (0.63mm)
751 TO 1000	22G (0.8mm)
1001 TO 1500	22G (0.8mm)
1501 TO 2250	20G (1.0mm)
2250 & LARGER	18G (1.25mm)

DETAIL OF DUCT SUPPORT

LARGER SIDE OF DUCT	ANGLE	Ø D ROD (M.S)
UPTO 2250	L 40 X 40 X 6	10
ABOVE 2250	L 50 X 50 X 6	16

REV. NO.	DESCRIPTION	DATE	DRN	CHKD	APPD
0	FOR APPROVAL	30.07.2021	JB	FJ	FJ

NTPC DOC NO: 2100-109-PVM-E-001

PROJECT: 3 x 200+3X500+1X500 MW NTPC KORBA TPP (FGD PKG)

OWNER: NTPC Limited

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA (U.P.)

JOB No. 466
STATUS PROJECT
CONTRACT

TITLE STANDARD DRAWING FOR DUCT FABRICATION & SUPPORTING ARRANGEMENT AND ERECTION & APPLICATION DETAIL OF INSULATION

BHEL DOC. NO. PE-V0-466-(571-13000-A)-A306
SHEET 2 OF 2 REV. 0

COMPUTER FILE NAME:

	TECHNICAL DATA SHEET	Doc. No.: SALE-21105325 - 10	Rev. 01
FLOWMORE PUMPS	PROJECT : NTPC-Korba Customer : NTPC Job no. : M22/DEL-19.BHEL NTPC document no. : 0270-109A-PVM-B-328 BHEL Doc. No.: PE-V0-466-(571-13000-A)-A204 ORDER NO : 22A-1477	2100-109-PVM-Y-002B Dt.- 13- 02- 2023	

S. No	Description	HORIZONTAL END SUCTION PUMP
General Information:		
1.	Application	Water Pump
2.	Duty	Continuous
3.	Quantity	1
4.	Liquid	Water
5.	Specific Gravity of Liquid	1.0
6.	Temperature (Deg. C)	Ambient
7.	Pump Design & Testing Standard	IS 5120 / IS 9137
Specifications:		
8.	Pump Make	FLOWMORE
9.	Pump Type	Horizontal End Suction Pump
10.	Pump Model / Size	F5625 / 125 x 100 mm
11.	No. of Stage	Single (1)
12.	Full Load Speed of Motor	1470 rpm
13.	Capacity (M^3/Hr.)	84 M^3/Hr
14.	Total Differential Head (Mtr.)	30 M
15.	Shut Off Head (Mtr.)	34.5 M
16.	Pump Efficiency	73.5 %
17.	Pump Input (BKW)	9.34 KW
18.	Motor Rating	15 KW / 4P
19.	Motor Type	TEFC / Horizontal Induction Motor /IE-2
20.	Type of Bearing Lubrication	Grease
21.	Type of Impeller	Enclosed
22.	Type of Pump Motor Coupling	Flexible (Spacer Type)
23.	Flange Drilling Standard	ANSI B16.5, 150 LBS
24.	NPSHR (At duty point)	2.3 M
25.	Noise Level	85 dBA at 1 M
26.	Vibration Level	75 Microns
27.	Bearing Type / Make	Antifriction (SKF / FAG)
Material of Construction		
28.	Casing	2% Ni. C.I. (IS-210, FG 260)
29.	Impeller	BRONZE (IS:318, LTB-II)

30.	Casing Wearing Ring	BRONZE (IS 318,LTB II)
31.	Impeller Wearing Ring	BRONZE (IS:318, LTB-II)
32.	Pump Shaft	ASTM A276 (S.S.-316)
33.	Shaft Sleeve	ASTM A276 (S.S.-316)
34.	Type of Sealing	Mechanical Seal
35.	Mechanical Seal	Faces carbon v/s Si.C
36.	Fasteners	M.S.-(IS-1367, Gr.- 4.6)
37.	Companion Flange	M.S. (IS.-2062)
38.	Bearings (Antifriction)	Bearing Steel (SKF/FAG)((6310 Z-C3))
39.	Base Plate	M.S. (FAB.)(IS - 2062)
40.	Accessories	Base Frame, Coupling, Coupling Guard, Foundation Bolts, Companion flanges with Hardware.

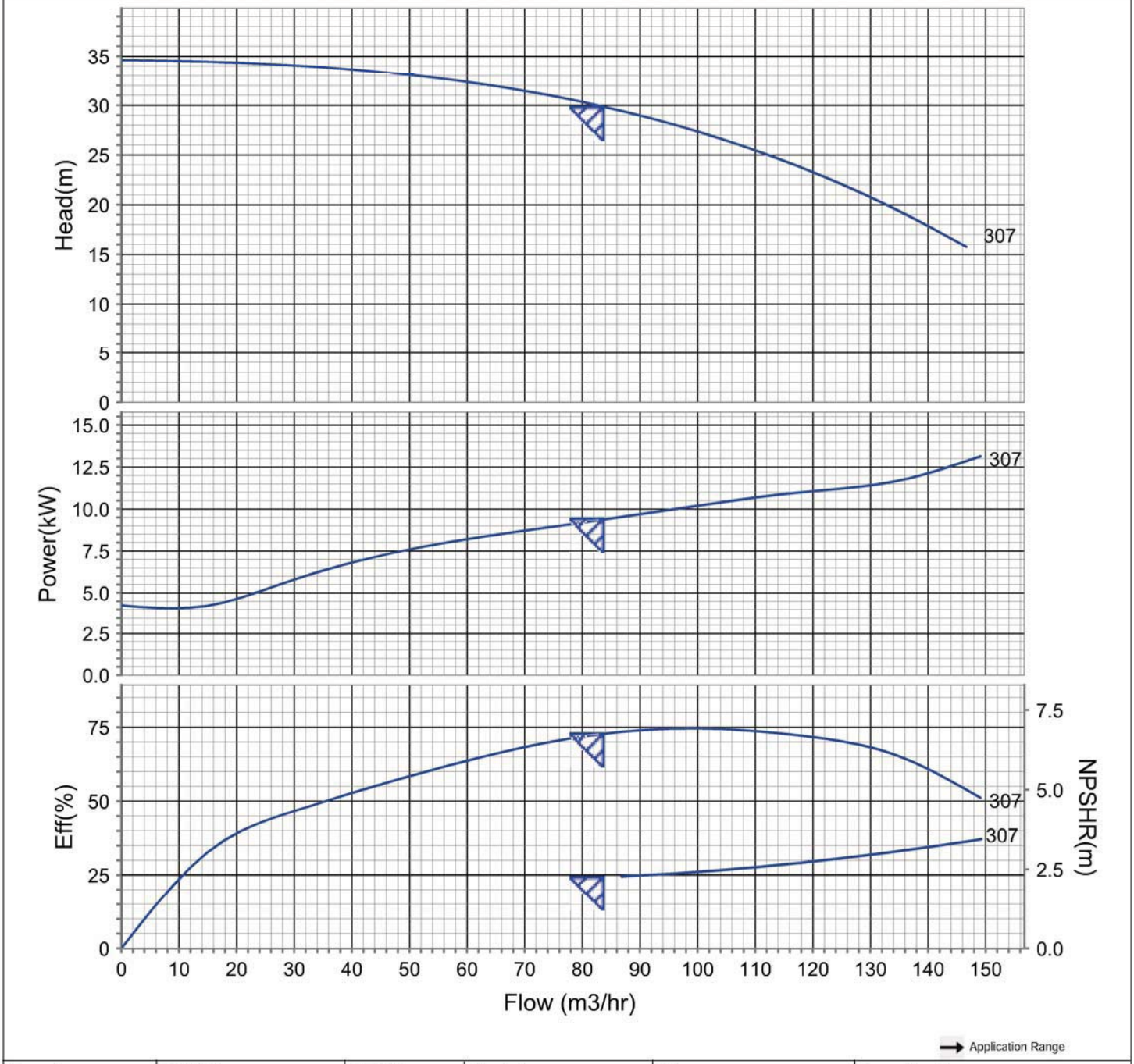
NOTE:

1) **Inspection & Testing shall be as per approved QAP.**

FLOWMORE Flow for life

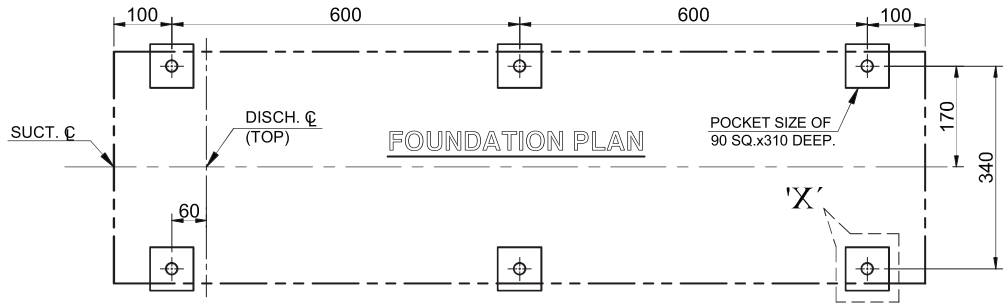
Performance Chart

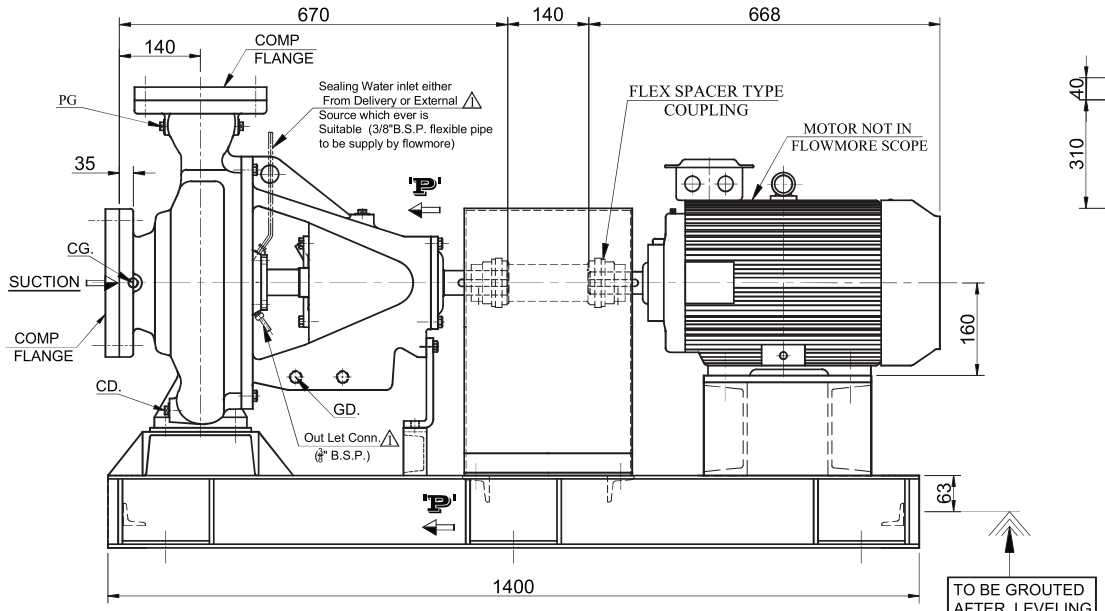
(							Liquid	-	
Consultant	-						Specific Gravity	1	
Project	NTPC KORBA						Viscosity	0	Cst
Application	WATER PUMP						Fluid Temperature	Ambient	Deg C
Speed (RPM)		PumpModel	F-5625-125x100				Solid Size	10	mm
1470		Flow	84.0 m3/hr	Head	30.0 m	Stage	1		

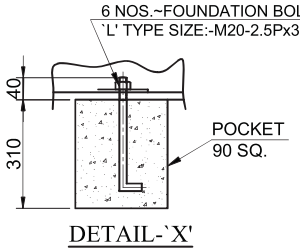


Pump Input	9.34 kW	NPSHA	Flooded	Size	Pump Nozzle
PrimeMover Power	15.0 kW	NPSHR	2.3 m	Suction (mm)	125
Eff	73.5 %	Shut Off Head	34.5 m	Discharge (mm)	100

Tag Number	-	Offer No	-	Prepared By/Checked By	Priyank Jain
				Date	







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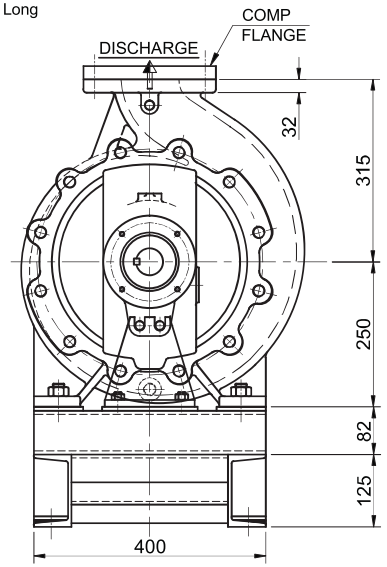


VIEW -'P'-'P'

FLANGE DETAIL AS PER ANSI B16.5, 150 LBS,			
SUCTION:------	125 N.B.	DISCHARGE:----	100 N.B.
FLANGE O.D.:---	254	FLANGE O.D.:---	228.6
P.C.D.:---------	215.9	P.C.D.:---------	190.5
NO. OF. HOLES:-	8	NO. OF. HOLES:-	8
DIA OF BOLTS:-	M20	DIA OF BOLTS:-	M16

PG	PRESSURE GAUGE	3/8" B.S.P
CG	COMPOUND GAUGE	3/8" B.S.P
CD	CASING DRAIN	1/2" B.S.P
GD	GLAND DRAIN	1/2" B.S.P

NOTE:-
1. DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. DIRECTION OF PUMP ROTATION:-***COUNTER CLOCKWISE*** WHEN LOOKING FROM DRIVING END.
3. STATIC LOAD (Pump Set With Motor) = 450 Kgs. (Approx.),
4. DYNMIC LOAD (Pump Set With Motor) = 570 Kgs. (Approx.),

MOTOR PARTICULARS			PUMP PARTICULARS (QTY.:- 02 Nos.)	
MAKE	--	HEM	FIG.	-- F 5625
FRAME	--	160L	SIZE	-- 125x100 (5"x4")
POWER	--	15 K.W.	STAGE	-- SINGLE
SPEED	--	1470 R.P.M.	SPEED	-- 1470 R.P.M.
VOLTS	--	415 ±10%	CAPACITY	-- 84 Cu. M/hr.
PHASES	--	THREE	HEAD	-- 30 Mtrs.
FREQUENCY	--	50 Hz.	PUMP INPUT (Sp. Gr. 1.0)	-- 9.34 K.W.
TYPE OF CONS.	--	H.S.S.	EFFICIENCY	-- 73.5%

Rev.No.	REVISION	SIGN	DATE
⚠	CHANGE AS MARKS	BALAM	11.02.2023

FLOWMORE
Flow for life

FLOWMORE LIMITED
NEW DELHI

JOB NAME :- WATER PUMP

PROJECT :- A/c. N.T.P.C.-KORBA

P.O. NO. :- 22A-1477 Dt.:- 04.10.2021

	NAME	DATE
DRN.	SUNIL	05.08.2022
CHD.	D.K.S.	05.08.2022
APPD.	P.K.S.	05.08.2022

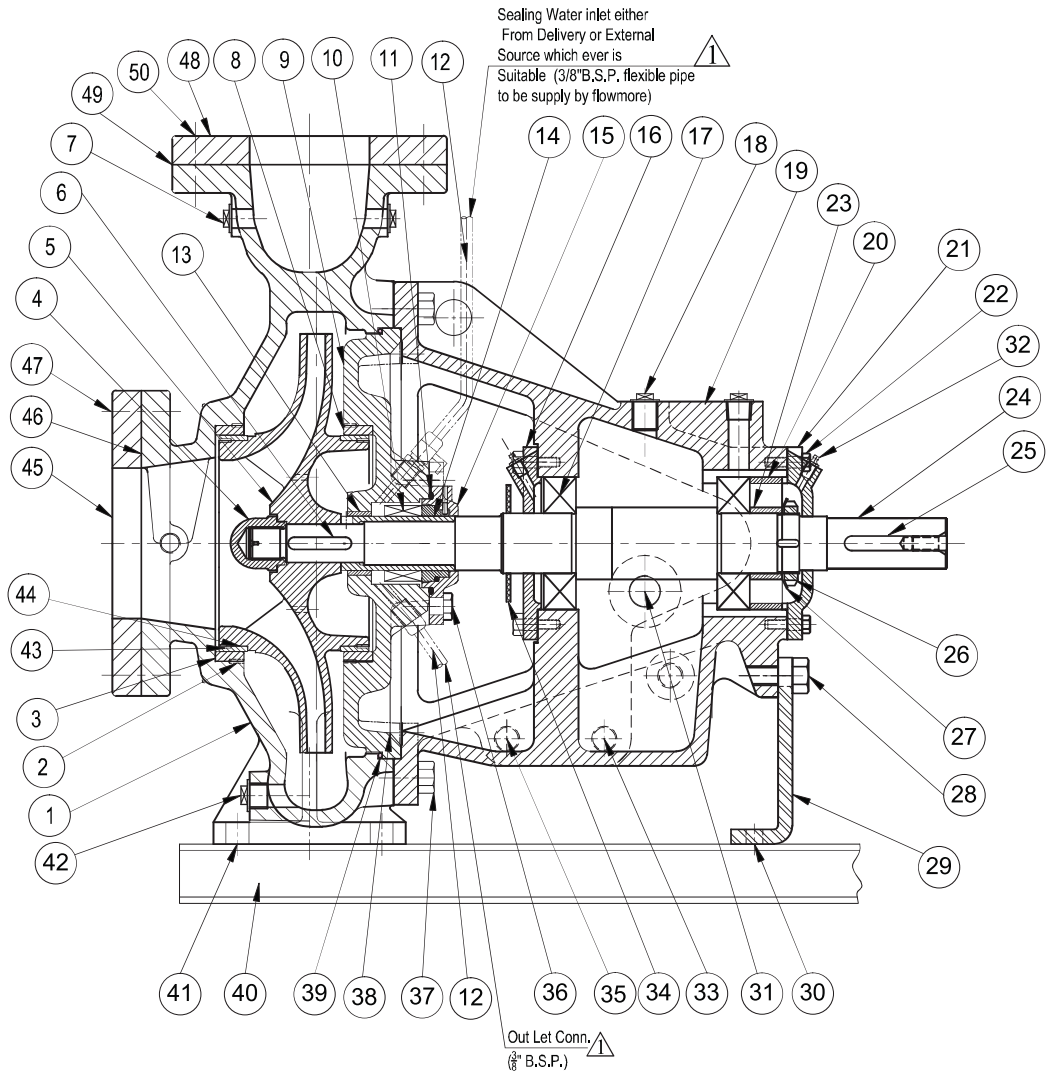
TITLE: GENERAL ARRANGEMENT DRG. FOR HORIZONTAL END SUCTION PUMP

SCALE N.T.S.

SHEET 1 OF1

DRAWING NO. GA-SALE21105325 10

SIZE A4 REV. 01



S. NO.	DESCRIPTION	QTY.	MATERIAL	
52	FLEXIBLE COUPLING (SPACER TYPE)	01	C.I.	
51	COUPLING GUARD	01	M.S. (Fab.)	
50	HEX. HD. CAP SCREW	08	M.S. (IS:-1367, Gr.-4.6)	
49	GASKET (DISCH. SIDE)	01	RUBBER	
48	COMPANION FLANGE (DISCH. SIDE)	01	M.S. (IS-2062)	
47	HEX. HD. CAP SCREW	08	M.S. (IS:-1367, Gr.-4.6)	
46	GASKET (SUC. SIDE)	01	RUBBER	
45	COMPANION FLANGE (SUC. SIDE)	01	M.S. (IS-2062)	
44	DOWEL PIN (Wearing Ring Impeller)	04	S.S.-304	
43	WEARING RING IMPELLER (Front & Back Side)	02	BRONZE (IS:318, LTB-II)	
42	PIPE PLUG	01	M.I.	
41	HEX. HD. BOLT WITH NUT & WASHER	04	M.S. (IS:-1367, Gr.-4.6)	
40	SKID BASE	01	M.S. (Fab.) (IS-2062)	
39	`O'- RING	01	NITRILE RUBBER	
38	STUD BOLT WITH NUT	02	M.S. (IS:-1367, Gr.-4.6)	
37	HEX. HD. CAP SCREW	12	M.S. (IS:-1367, Gr.-4.6)	
36	HEX. HD. CAP SCREW WITH WASHER	04	S.S.-316	1
35	PIPE NIPPLE	01	STEEL	
34	WATER SLINGER	01	RUBBER	
33	PIPE PLUG	02	M.I.	
32	GREASE RELEASE FITTING	02	STEEL	
31	PIPE PLUG	01	M.I.	
30	HEX. HD. BOLT WITH NUT & WASHER	02	M.S. (IS:-1367, Gr.-4.6)	
29	SUPPORT FOOT	01	M.S.(Plate)	
28	HEX. HD. CAP SCREW WITH WASHER	02	M.S. (IS:-1367, Gr.-4.6)	
27	BRG. LOCK WASHER	01	STEEL	
26	BRG. LOCK NUT	01	STEEL	
25	KEY FOR COUPLING	01	EN-8	
24	PUMP SHAFT	01	ASTM A 276,S.S.-316	
23	BEARING SPACER (INNER)	01	STEEL	
22	HEX. HD. CAP SCREW	08	M.S. (IS:-1367, Gr.-4.6)	
21	BEARING COVER	01	C.I. (IS-210, FG.-260)	
20	BEARING SPACER (OUTER)	01	STEEL	
19	FRAME/BEARING HOUSING	01	C.I. (IS-210, FG.-260)	
18	PIPE PLUG	02	M.I.	
17	ANTI FRICTION BEARING (N.D.E.)(6310 Z -C3)	02	BRG. STEEL (SKF/FAG Make)	
16	BEARING COVER	01	C.I. (IS-210, FG.-260)	
15	SEAL COVER/HOUSING	01	ASTM A 743, S.S.-(CF 8)	1
14	SHAFT SLEEVE	01	ASTM A276,S.S.-316	
13	STUFFING BOX BUSH	01	BRONZE (IS-318, LTB-II)	1
12	SEALING LINE (Out Let & Inlet)	02	S.S.FLEXIBLE BRIDED PIPE	1
11	'O' RING	01	NITRILE RUBBER	1
10	MECH. SEAL ASSY.	01	Faces Carbon v/s Si. C.	1
09	BACK COVER/BACK HEAD	01	2% Ni. C.I. (IS-210, FG.-260)	
08	WEARING RING CASING (Back Side)	01	BRONZE (IS:318, LTB-II)	1
07	PIPE PLUG	02	M.I.	
06	KEY FOR IMPELLER	01	EN-8	
05	IMPELLER	01	BRONZE (IS:318, LTB-II)	
04	IMPELLER NUT	01	STEEL	
03	WEARING RING CASING (Front Side)	01	BRONZE (IS:318, LTB-II)	1
02	DOWEL PIN	04	En-8/En-9	
01	CASING (VOLUTE)	01	2% Ni. C.I. (IS-210, FG.-260)	

✻ THESE ITEM ARE NOT SHOWN IN THIS DRAWING.

NOTE:-
DIRECTION OF PUMP ROTATION:- ***COUNTER CLOCK WISE***, WHEN LOOKING FROM DRIVING END.

Rev.No.	REVISION	SIGN	DATE
1	CHANGE AS MARKS	BALAM	11.02.2023

PUMP PARTICULARS (QTY.:- 02 Nos.)

FIG.	--	F 5625
SIZE	--	125x100 (5"x4")
STAGE	--	SINGLE
LUB.	--	GREASE

FLOWMORE — Flow for life

FLOWMORE LIMITED
NEW DELHI

JOB NAME :- WATER PUMP

CLIENT

PROJECT :- A/c. N.T.P.C.-KORBA

P.O. NO. :- 22A-1477 Dt.:- 04.10.2021

	NAME	DATE
DRN.	SUNIL	05.08.2022
CHD.	D.K.S.	05.08.2022
APPD.	P.K.S.	05.08.2022

TITLE: CROSS SECTIONAL DRAWING FOR HORIZONTAL END SUCTION PUMP

SCALE N.T.S.

SHEET 1 OF1

DRAWING NO. CSD-SALE21105325 10

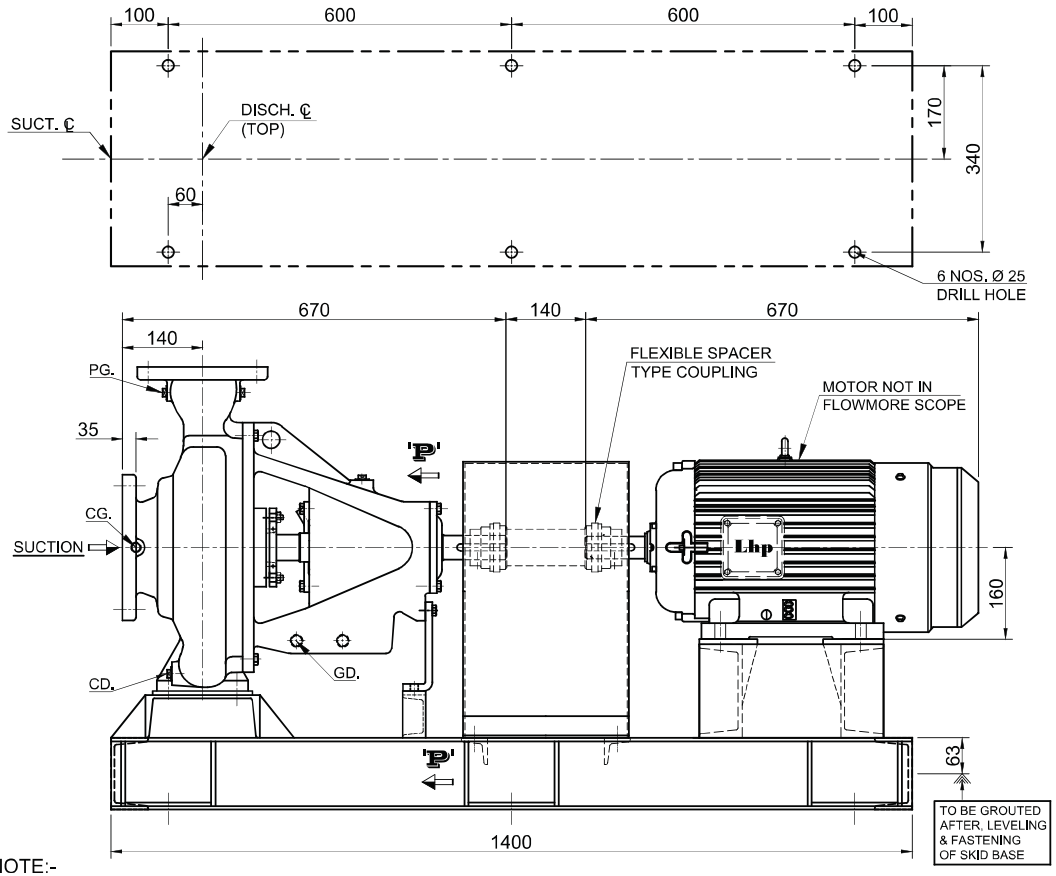
SIZE A4 | REV. 01

APPLICABLE FOR ANNEXURE-I, ITEM NO. B1c, PUMPS

TECHNICAL DATA SHEET & GA DRAWING FOR CENTRIFUGAL PUMP FOR UAF UNIT

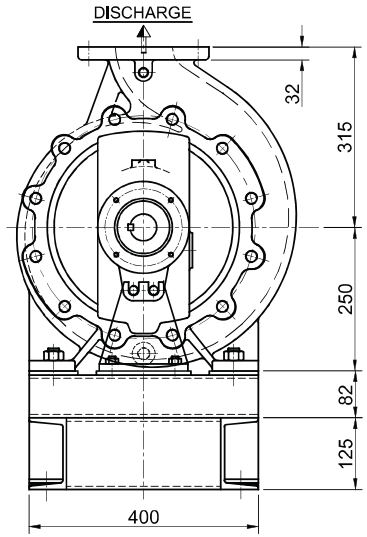
Customer	**NTPC**	**Job No.**	**M21/DEL-81.BHEL**
Project	**2X500 MW NTPC MOUDA TPP STAGE-I (FGD SYSTEM PACKAGE)**	**Date**	**15.07.2021**
BHEL Doc. No.	**PE-V0-444-571-A204**		

Sr.No.	Description	Details
1	Application	UAF Centrifugal Pump
2	Location	UAF (FGD electrical Cum Control Building)
3	Duty	Continuous
4	Quantity	01 Nos.
5	Liquid	Water
6	Specific Gravity of Liquid	1
7	Temperature (Deg. C)	Ambient
8	Pump Make	FLOWMORE
9	Pump Type	Horizontal End Suction Water Pump
10	Pump Model	5625
11	Size	125x100
12	Full Load Speed of Motor	1480 rpm
13	Capacity (M3/Hr.)	81
14	Total Differential Head (Mtr.)	30 M
15	Shut Off Head (Mtr.)	34.5 Mtr.
16	Pump Efficiency	72%
17	Pump Input (BKW)	9.14 KW
18	Motor Rating	15KW/4P
19	Motor Make	LHP
20	Type of Impeller	Enclosed
21	Type of Pump Motor Coupling	Flexible
22	Noise Level	85 dBA at 1 M
23	Vibration Level	75 Microns
24	Lantern ring	Bronze
25	Casing	2% NiCI (IS-210, FG-260)
26	Impeller	BRONZE (IS-318, Gr.II)
27	Casing Wearing Ring	BRONZE (IS-318, LTB V)
28	Pump Shaft	SS-316
29	Shaft Sleeve	SS-316
30	Type of Sealing	Gland Packing
31	Gland Packing Type	Non – Asbestos
32	Base Plate	IS-2062
33	Operating Range	-40% to 120% of Duty Point
34	Painting	Light Grey - RAL 7035



FLANGE DETAIL AS PER ANSI B16.5, 150 LBS,.			
SUCTION:------	125 N.B.	DISCHARGE:----	100 N.B.
FLANGE O.D.:---	254	FLANGE O.D.:---	228.6
P.C.D.:---------	215.9	P.C.D.:---------	190.5
NO. OF. HOLES:-	8	NO. OF. HOLES:-	8
DIA OF BOLTS:-	M20	DIA OF BOLTS:-	M16

PG	PRESSURE GAUGE	3/8" B.S.P
CG	COMPOUND GAUGE	3/8" B.S.P
CD	CASING DRAIN	1/2" B.S.P
GD	GLAND DRAIN	1/2" B.S.P



VIEW -'P'-'P'

NOTE:-
1. DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. DIRECTION OF PUMP ROTATION:-***COUNTER CLOCKWISE*** WHEN LOOKING FROM DRIVING END.
3. STATIC LOAD (Pump Set With Motor) = 450 Kgs. (Approx.),
4. DYNMIC LOAD (Pump Set With Motor) = 580 Kgs. (Approx.),

MOTOR PARTICULARS			PUMP PARTICULARS		
MAKE	--	LHP	FIG.	--	F 5625
FRAME	--	160 L	SIZE	--	125x100 (5"x4")
POWER	--	15 K.W.	STAGE	--	SINGLE
SPEED	--	1480 R.P.M.	SPEED	--	1480 R.P.M.
VOLTS	--	415±10%	CAPACITY	--	81 Cu. M/hr.
PHASES	--	THREE	HEAD	--	30 Mtrs.
FREQUENCY	--	50 Hz.±5%	PUMP INPUT (Sp. Gr. 1.0)	--	9.13 K.W.
TYPE OF CONS.	--	H.S.S.	EFFICIENCY	--	72%

FLOWMORE LIMITED
NEW DELHI

JOB NAME :- RECIRCULATION WATER PUMP FOR MODULAR UAF UNIT

	NAME	DATE
DRN.	SUNIL	02.01.2019
CHD.	D.K.S.	02.01.2019
APPD.	P.K.S.	02.01.2019

TITLE: GENERAL ARRANGEMENT DRAWING FOR HORIZONTAL END SUCTION PUMP

SCALE N.T.S.
SHEET 1 OF1
SIZE A4
REV. 01

DRAWING NO. GA-SALE18123878 10