

TELANGANA STATE POWER
GENERATION CORPORATION LIMITED
(TSGENCO)

1X800 MW TSGENCO KOTHAGUDAM
TPS STAGE –VII,PALONCHA

VOLUME – II – B

**TECHNICAL SPECIFICATION
FOR**

AIR CONDITIONING SYSTEM

SPECIFICATION NO.:PE-TS-410-553-A001 Rev 0



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


VIVEK KUMAR SA KHAN Praveen Kishore

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		VOLUME : II B
		REV 00
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TITLE

1X800 MW KOTHAGUDEM TPS
AIR CONDITIONING SYSTEM
INTENT OF SPECIFICATION

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SECTION A

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SECTION-A

INTENT OF SPECIFICATION

Praveen Kishore
SA Khan Praveen Kishore
Vivek Kumar
VIVEK KUMAR



TITLE

1X800 MW KOTHAGUEDEM TPS**AIR CONDITIONING SYSTEM****INTENT OF SPECIFICATION**

SPECIFICATION NO. PE-TS-410-553-A001

VOLUME II B

SECTION A

REV 00

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1.0 INTENT OF SPECIFICATION

- 1.1 The specification covers design, engineering, manufacture, supply / procurement, inspection and testing at vendor's / sub vendor's / manufacturer's works, painting, forwarding, proper packing and shipment and delivery at site, unloading, handling & transportation, storage, preservation , security / safety at site , Erection & Commissioning, minor civil & structural (as applicable) works as required on FOR site basis, Performance and guarantee testing / performance testing and handing over to BHEL's customer of **AIR CONDITIONING SYSTEM** as per details in different sections / volumes of this specification for **1X800 MW KOTHAGUEDEM TPS** at KOTHAGUEDEM, TELANGA.
- 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 **AIR CONDINTIONING 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 high 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.
- 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.



TITLE

1X800 MW KOTHAGUDEM TPS**AIR CONDITIONING SYSTEM****INTENT OF SPECIFICATION**

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- 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 under Vol-III of the specification **within 10 days of receipt of tender documents**. 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 enclosed schedule (in Vol – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.
- 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 referred relevant clause(s) of GCC.

VOLUME : IIB

SECTION- B

PROJECT SYNOPSIS AND GENERAL INFORMATION


VIVEK KUMAR SA Khan Praveen Kishore

CONTENT

CLAUSE NO.	DESCRIPTION
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2.00.00	APPROACH TO SITE
3.00.00	LAND
4.00.00	SOURCE OF COAL
5.00.00	SOURCE OF WATER
6.00.00	ASH DISPOSAL AREA
7.00.00	SALIENT DESIGN DATA


VIVEK KUMAR SA Khan Praveen Kishore

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SECTION-B

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 would be set up by Telangana State Power Corporation Ltd. (TSGENCO) at Kothagudem, Telangana. The proposed Power Plant will be installed adjacent to the existing D colony of Kothagudem Thermal Power Station, at Kothagudem.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

Site is located in the existing D Colony of Kothagudem Thermal Power Station, which is at a distance 30 km from temple town of Bhadrachalam and 300 km from Hyderabad by road. The Nearest railway station is Bhadrachalam Road (Known as Kothagudem) at a distance of 12 km. Kothagudem- Bhadrachalam National Highway branches off to the power station site near village Paloncha.

3.00.00 LAND

Land is primarily required for the main plant & auxiliaries (BTG) and balance of plant (BOP) like ash handling, coal storage, cooling tower, switchyard etc., which is available within the existing plant boundary.

The existing colony is to be dismantled, and the land of about 137 acres will be used for the main plant building, water facilities, switchyard, coal handling etc. The raw water reservoir will be located adjacent to the existing raw water reservoirs.

230 acres of land required for Ash Dyke will be procured. Land is available for staff colony, which is to be constructed by the EPC contractor.

4.00.00 SOURCE OF COAL

100% Imported and Blended coal (50% imported + 50% indigenous) will be used. Indigenous coal shall be sourced from Suliyari coal mines, Madhya Pradesh.

5.00.00 **SOURCE OF WATER**

Source of water (total quantity of water is 2192 m³/hr) is Godavari River near Burgampahad & water will be pumped through existing GRP pipe line (of length approx. 26 km).

6.00.00 **ASH DISPOSAL AREA**

Ash shall be dumped in the ash dump area which will be about 9 km from plant. The ash dyke area of 230 acres is adequate for 1x800 MW unit as per MOEF norms.

7.00.00 **SALIENT DESIGN DATA**

7.01.00 Meteorological data of site is given below:-

Elevation above MSL	:	89 m
Monthly highest temperature	:	44.9 °C
Monthly lowest temperature.	:	12.9 °C
Rainfall		
	Average.:	1031 mm
	Max. :	100 mm/ hr
Mean Wind speed	:	44 m/sec
Relative Humidity		
	Max :	82%
	Min :	35%
Seismic Zone	:	Zone-III as per IS- 1893 (Part-IV)

[Climatological data of Khammam is attached for reference].


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TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-410-553-A001

VOLUME II B

SECTION C1

REV. 00

DATE: APRIL 2015

SECTION: C1

SPECIFIC TECHNICAL REQUIREMENT


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SA Khan Praveen Kishore

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1. FUNCTION

The purpose of the system is to provide Air-Conditioning for different areas of Kothagudem (1 x 800 MW) under the scope of BHEL.

2. SYSTEM DESCRIPTION

2.1 AC AREAS WITHIN POWER HOUSE BUILDING & SERVICE BUILDING(AC PLANT-1)

a) Water-cooled Chilled water type air conditioning plant shall be provided to cater to the air conditioning requirements of the following areas of unit 12:

- Control Room.
- CER Room
- Computer Room
- UPS Room
- SWAS Room
- Shift in-charge room
- Office area etc.
- Service Building

b) The air conditioning plant shall comprise of 2 x 100% Screw Chilling machines. The condenser cooling water shall be circulated through these units by means of 2 x 100% horizontal split casing centrifugal pump sets and 2 x 100% FRP cooling towers. The chilled water produced by the chilling units shall be circulated to the air handling units by means horizontal centrifugal pump sets. These AHU shall be located in AHU rooms located adjacent to air-conditioned areas in Power House Building (AHU room shall contain 2 x 50% capacity AHU). The conditioned air from AHUs is distributed to the air-conditioned areas by galvanised sheet steel ducting and extruded Aluminium grilles / diffusers with volume control dampers and supporting frames. The return air is led back to the AHU Room in ducts for air conditioned areas at 17.0M level in control tower. For balance areas, i.e air conditioned areas at 8.5M level in control tower for unit-12, the return air is collected above the false ceiling and led back to the AHU rooms which acts as mixing plenum for return and fresh air.

c) FCU shall be provided for SWAS room for Unit-12.

d) Controls for the AC & Ventilation (common) shall be PLC based.

2.2 ESP BUILDING (AC PLANT-2)

- 3 Nos (2W + 1S) Water cooled precision type Package AC shall be provided for ESP control room for unit i.e **unit 12**.

Condenser cooling water for these Air Conditioners shall be supplied from main plant ACW system through Non-Chemical Water Treatment Device.


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2.3 ADMINISTRATION BUILDING

Air cooled type Package AC shall be provided for each floor of administration building.

2.4 SPLIT TYPE AIR CONDITIONERS

Split type air conditioners (air cooled) shall be provided to cater to the air conditioning requirements of Compressor house control room areas having workstation for auxiliary plant. For areas requiring multiple working split ACs, One (1) No. standby (of same capacity) shall be provided. (Only those aux. control rooms which are under scope of BHEL). Local isolator / MCB shall be provided with split units.

Hand operated remote and other accessories as specified.

Local Distribution Boards containing Switch / MCB shall be provided for Split Air Conditioners, and FCUs. Each split unit shall also be provided with suitable rating stabiliser.

Single phase electrical feeders of following ratings shall be provided for split units. Bidder to ensure the suitability as per these feeder requirement.

Capacity of Split AC	Single phase feeder
1.5 TR	2.2 KW
2TR	3.0 KW


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3. DESIGN CRITERIA

3.1 SYSTEM DESIGN CRITERIA - AIR CONDITIONING SYSTEM

- The outside design conditions considered are as follows:-

	Summer	Monsoon	Winter
DBT (°C)	42.6	30.9	20.8
WBT (°C)	26.6	25.8	18.4

- The inside design conditions to be maintained are as follows:-
- 22°C ± 1°C & RH 55% ± 5% for control room, CER, Computer room, UPS rooms, AVR room etc.
- 24°C ± 1°C & RH 55% ± 5% for non critical areas like offices, conference room, SWAS room, etc. and the areas served by split AC.

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- A design margin of 10% on total sensible and latent heat shall be considered while designing the AC Plant capacity for each area.
- For winter heating load calculation, 50% of combined light load and eqpt. / panel load as available in the room shall be considered.
- For other design parameters refer to clause 5.01.00 of section C2-A, customer specifications.

3.2

SYSTEM CAPACITY AND CONFIURATION:

a) For AC Plant-1:

2 x 350 TR Actual capacity screw chillers (1 working + 1 Standby) shall be provided.

b) For AC Pant-2:

3 x 20 TR Actual capacity Precision type package units (2 working + 1 Standby) shall be provided.

3.3

LAYOUT CONSIDERATIONS:

a) AC PLANT-1

- The central chilled water plant, Condenser Water & Chilled Water Pumps for AC Plant shall be housed in AC Plant Room at 0.0 M level in E-F Bay Power House Building.
- The AHUs for this AC Plant would be located as under:
 - 2 AHUs (2 x 50 %) for areas at 17 m i.e CCR, CER unit 12, computer rooms, shift in-charge, etc, located in AHU Room at 24 M level of Power House Building in BC Bay col 2-5.
 - 2 AHUs (2 x 50%) for areas at 8.5 m i.e UPS room etc, located in AHU Room at 8.5 M level of Power House Building in EF Bay col 1-2.
 - FCU for SWAS (dry panel room).
- The Cooling Towers, Make-up water Storage Tank, Expansion Tank shall be located at 32.5 M level in DEF Bay.
- 3 T Capacity Chain pulley block with Monorail arrangement shall be provided for the AC Plant room only for maintenance purpose.

b) AC PLANT-2

- Water Cooled Precision package units shall be housed in each ESP PAC Room at 5.7 M level of ESP Building for Unit-12.

3.4

SPECIAL CONSIDERATION

- Water flow rate for chilled water pump selection : 0.7 cmh/TR
- Water flow rate for condenser water pump selection : 1.0 cmh/TR


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- c) Condenser water pumps, chilled water pumps, AHUs and FCUs shall have further 10% margin on their flow capacities.
- d) Further design margins in various equipment shall be as per relevant clauses of section C2-A, customer specifications.
- e) All equipment shall be of high quality and high efficiency meeting the stipulated power consumption as defined elsewhere in the specifications.

4. AC EQUIPMENT

4.1 Water Cooled Chiller Package

- a) Refer to clause 4.01.00 & 6.03.00 and other relevant clauses of section C2-A, customer specifications.
- b) The IKW/TR of screw chillers shall not be more than **0.7** at 100%.
- c) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with each screw chiller as per customer approved PID.

4.2 WATER Cooled Precision Package AC

Each water cooled precision type package

Refer to clause 4.02.00, 4.03.00, & 6.12.01 and other relevant clauses of section C2-A, customer specifications

4.3 CHILLED AND CONDENSER WATER PUMP SETS

Each Chilled water circulating pump set

- a) Refer to clause 6.04.00 and other relevant clauses of section C2-A, customer specifications.
- b) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with pump as per customer approved PID

4.4 COOLING TOWER

- Design ambient wet bulb temp: 27.6 deg C.
- Approach: 4 deg C.
- Induced draft (single cell) FRP type shall consist of all accessories i.e. fan, motor, FRP basin, FRP louvre, PVC eliminators, nozzles, make up connection, drains overflow & piping, valves & fittings, strainer of brass wire mesh, ladder and supporting structure and all accessories as specified shall be provided.
- Refer to clause 3.01.07, & 6.05.00 and other relevant clauses of section C2-A, customer specifications

4.5 AIR HANDLING UNIT (DOUBLE SKIN TYPE)

Each air handling unit shall comprise of the following:-


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SA Khan Praveen Kishore

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- a) Refer to clause 6.08.01 and 6.08.02, and other relevant clauses of section C2-A, customer specifications.
- b) High efficiency filter having an efficiency of 99% down to 5 microns mounted in supply air duct shall be provided for air conditioning of all areas excepting areas served by FCUs.
- c) Dry panel type pre-filters (50mm thick) having efficiency of 90% down to 10microns shall be provided for all other AC areas.
- d) Motors shall be installed inside the AHU.
- e) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc shall be provided with pump as per customer approved PID
- f) Drain piping from the AHUs up to nearest drain point.
- g) Serrated rubber pads for vibration isolation

4.6

STRIP HEATER PACKAGE AND HUMIDIFICATION PACKAGE

- a) One set of electrical strip heater package of suitable capacity shall be provided in supply air duct. Heater package shall be connected with thermostat / Humidistat which will be provided in return air path inside AHU Room / Package AC Room.

Temp gauge, temp element shall also be provided and the same shall be hooked with PLC system. RH and temp sensor shall be provided and the same shall be hooked with PLC system.

- b) One No. electrode humidification system comprising heater, humidistat, water tank, low level switch over flow, draining, make up connection, float valves etc for each AHU Room.
- c) Refer to relevant clause 3.06.00, 6.14.01, 6.14.02 and other of section C2-A, customer specifications

4.7

SHEET METAL WORK

- a) Refer to clause 6.10.00 and other relevant clauses of section C2-A, customer specifications.
- b) Supply air diffusers / grilles (Frame and Louvers of Diffuser/Grilles shall be of extruded aluminium of 1.2 mm thick section, duly powder coated) with volume control dampers. Return air Diffusers will have no Volume control Damper.
- c) For fire damper refer to clause 6.10.00, 4.01.00, 6.10.11(ii) and other relevant clauses of section C2-A, customer specifications.
- d) Motorized fire damper will be installed at supply and return air duct at suitable locations where duct pass through wall & floors for ease of isolation, maintenance and as well as for emergency operation. Fire damper in the supply and return air duct will be closed on receiving fire signal from fire protection system and shall also be possible manually from remote control panel. Necessary arrangement shall be


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incorporated in the duct for providing duct mounted multi- sensor detectors in the return air duct for all air conditioned areas. Also respective Air Handling Units, Air washers/UAFs shall trip on receiving fire signal from fire protection system

4.8 SMOKE EXHAUST FANS

- a) Refer to clause 2.08.06, 3.07.00 and other relevant clauses of section C2-A, customer specifications.

4.9 INSULATION

- a) Refer to clause 6.11.00 and other relevant clauses of section C2-A, customer specifications

4.10 PIPING VALVES ETC

- a) Refer to clause 6.06.00, 6.07.00 and other relevant clauses of section C2-A, customer specifications

4.11 ONLINE NON CHEMICAL WATER TREATMENT EQUIPMENT

- a) Refer to clause 6.14.03 and other relevant clauses of section C2-A, customer specifications.

4.12 ELECTRICAL ITEMS

- a) Refer to clause 6.16.00 and other relevant clauses of section C2-A, customer specifications and section C-3, electrical portion of specifications.

4.13 For other items refer to relevant clauses of section C2-A, customer specifications

5. CONTROL PHILOSOPHY

A common PLC based control system shall be provided for AC & Ventilation system. The PLC based control system shall cover the followings.

- AC system for main power house.
- AC system for ESP building.
- Air washer & UAF unit.
- Refer to clause of section, C-4 of specification.

5.1 SAFETY CONTROLS

All necessary measuring – control instruments & control system shall be provided. With following compressor & evaporator interlock in the control panel of the Chiller Package.

- a) High discharge pressure cut-out (HP)
- b) Low suction pressure cut out (LP)
- c) Oil pressure cut-out (OP)


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- d) Chilled water flow switch
- e) Anti-freeze thermostat (AFT)
- f) Airstat / safety thermostat with heaters of the AHU's

5.2 OPERATING CONTROL

All operating control as necessary shall be provided. However following minimum control shall be provided. Central chilled water system shall have the following controls:

- a) Automatic capacity control system.
- b) Automatic unloaded starting device
- c) Operating Thermostat
- d) Unloading solenoid valves (if applicable)
- e) 3 way flow control valve at the AHU's
- f) Operation / Sequence Interlock of the Air conditioning system shall be as under:
- g) Condenser fan is started.
- h) The Air Handling Unit is started.
- i) Chiller Pump is started
- j) Chilling unit is started

5.3 INTERFACE WITH DCS

Following hardwired signals shall be provided in the DCS for monitoring purpose

- a) Temperature & Humidity.
- b) AC Plant On / Off Status.
- c) Pump Run / Trip.
- d) AHU Run / Trip.
- e) General AC Plant Warning.
- f) The operation of the air conditioners shall be done from local start-stop push button. Peripherals serial link shall be provided for the transfer of important signals to DCS in the central control room.

6.0

SPECIFIC REQUIREMENT

Efficiency of centrifugal fan and pump shall not be less than 70%.

Electrical feeder suitable for following motor rating shall be provided for following equipment. Vendor to ensure that motor rating is not more than the rating mentioned below.

Sr. no.	Items	Motor rating (Kw)
1.	Screw Chiller	350


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2.	Chilled Water Pump	45
3.	Condenser Water Pump	50
4.	AHU for Power House at 24.0Mtr.	18.5
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7.0 GENERAL

- 1) Basis of design, all calculations including heat load calculations for summer seasons, 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 stage.
- 2) Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.
- 3) Vendor to include level gauge & level switch for each tank for alarm & trip of the pumps. Also include one no. Pressure switch for each pump
- 4) All drawings and documents shall be computer based.
- 5) All commissioning spares & consumables for trouble free operation shall be provided.
- 6) 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.
- 7) 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.
- 8) Inserts or any support arrangement for fixing ducting, fans, piping etc. shall not be provided by BHEL. Necessary supports may be taken from nearest structure / walls / roofs / floors etc. by Vendor.
- 9) Fixing frame works for diffusers and grilles in the scope of Vendor.
- 10) Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.
- 11) Necessary supports and structures / frames etc. as required for supporting the duct / piping / equipments etc. as lump-sum basis is in the scope of Vendor and no unit rates shall be applicable for these items.
- 12) **Drain piping within room up to the drain point to be provided by the Vendor.**
- 13) Vendor to furnish schedule of power and control cables. Vendor to furnish cable termination details interconnection drawings etc. during detail engineering stage.
- 14) The tools and machine required for erection of equipment shall be arranged by Vendor.
- 15) Tools & tackles as required for regular maintenance shall be supplied by Vendor.
- 16) Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.


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- 17) Instrument for testing shall be calibrated by Air-conditioning plant supplier before taking up testing.
- 18) Temperature gauges shall be provided with thermo wells and fixing arrangement.
- 19) Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.
- 20) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.
- 21) Bidders shall guarantee to maintain specified inside design conditions during summer, monsoon and winter and also even if the internal equipment load varies from 100% to 25%.
- 22) Besides the system performance as above, bidder shall guarantee major technical parameters of various equipments as per design basis / details furnished.
- 23) The guarantee tests shall cover but not limited to the following rated parameters for smooth operation of ventilation system.
 - Design dry bulb temperature and relative humidity of conditioned air, Auxiliary power consumption, Vibration and noise level etc.
 - Performance test of the Ventilation system shall be carried out at site after proper installation. The site test shall include performance testing of equipment for 72 continuous hours in summer or monsoon and 24 continuous hours in winter. Bidder, as may be required to carry out site tests shall arrange all instruments, tools etc.
 - All calibrated instruments to be used for the tests at manufacturer's works/site shall be arranged by the bidder. Any Electrical/C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provide free of cost which are categorically listed in the Electrical scope sheet of technical specification.
- 24) Motorized fire damper will be installed at supply and return air duct at suitable locations where duct pass through wall & floors for ease of isolation, maintenance and as well as for emergency operation. Fire damper in the supply and return air duct will be closed on receiving fire signal from fire protection system and shall also be possible manually from remote control panel. Necessary arrangement shall be incorporated in the duct for providing duct mounted multi- sensor detectors in the return air duct for all air conditioned areas. Also respective AHU, Air washers/UAFs shall trip on receiving fire signal from fire protection system
- 25) For motorized fire damper / 3 Way valve actuators, power supply shall be derived by vendor from respective control panels. BHEL will not provide any feeder for fire damper / 3 Way/


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Motorized valve. Suitable transformer shall be provided by bidder (if required) to derive the power input.

- 26) Feeder for a combination of fire damper/ valves etc. shall be derived from respective control panel by vendor. Distribution through junction box/ distribution board shall be in vendor scope and shall have provision for isolation of individual fire damper/ valves.
- 27) Tender drawings enclosed form the part of specification and the bidder shall check the space requirements.
- 28) Bidder should suitably group the signals coming from various instruments etc. & the same shall terminate in local JB, from Local JB common cable to PLC / 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. Only those items shall be provided free of cost which are categorically listed in the Electrical scope sheet of technical specification.
- 29) 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.
- 30) 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 net connectivity at their end.
- 31) 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.
- 32) The drawings/ documents submitted by vendor shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor's account. For any clarification/discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place any number of time as per the requirement for across the table discussions/ finalizations/ submissions of drawings.
- 33) Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Air-conditioning system vendor.
- 34) Flat, platform type RCC / PCC foundation shall be provided for installing Chiller/ PUMP, AHU and FAN etc. Vendor shall fix the equipment using anchor fasteners to secure the equipment obtain parameters related to vibration and noise.


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- 35) 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.
- 36) RCC foundation of cooling tower shall be provided by BHEL. However, steel beam / joist etc as required shall be supplied by air-conditioning plant supplier.
- 37) Air-conditioning plant supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.
- 38) Each motor terminal box shall be provided with cable gland and lugs for the size and type of power and control cable of respective motor.
- 39) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.
- 40) The bidder's proposal shall be for equipment in accordance with the tech. Specification.
- 41) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification.
- 42) Necessary duct mounted Booster fan (if required) to maintain the static pressure for Precision AC shall be provided without any implication.

6. **EXCLUSIONS**

Items of works listed below are excluded from scope of the air-conditioning plant supplier.

- a) Construction of AC plant room, air handling unit room, foundations for AC equipments.
- b) False ceiling, drop ceiling.
- c) Slab cut out for running ducts, pipes, cables, grilles/dampers. Underground masonry trenches and masonry risers. However minor civil work like making opening to suit / finishing of opening, sealing of duct opening, grouting of foundation bolts including special type of grouting like GPX2 etc. are in the scope of AC system vendor.
- d) Provision of drain traps / points,
- e) For Electrical scope, refer Electrical scope matrix sheet.


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TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
AIR-CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-410-553-A001

VOLUME II B

SECTION C2-A

REV. 00

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SECTION: C2-A
CUSTOMER SPECIFICATION


VIVEK KUMAR
SA Khan Praveen Kishore

TECHNICAL SPECIFICATION FOR AIR CONDITIONING SYSTEM


VIVEK KUMAR
SA Khan, Praveen Kishore

AIR CONDITIONING SYSTEM

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AIR CONDITIONING SYSTEM

1.00.00 **INTRODUCTION**

1.01.00 The purpose of the system is to provide Air Conditioning System for the different areas of 1X800 MW Supercritical Thermal Power Plant, Stage – VII Unit #12 at Kothagudem Thermal Power Station, Telangana.

Various control rooms in power station, housing a group of sophisticated and precision control panels and desks call for controlled environment for proper functioning and for the comfort of working personnel.

2.00.00 **SYSTEM DESCRIPTION**

2.01.00 The air conditioning system shall cover the following areas as a minimum:

- a. Power House Building including Control Room
 - i. Unit Control Room
 - ii. Control Equipment Room (CER)
 - iii. Shift Charge Engineers' Rooms
 - iv. Computer Room
 - v. Uninterrupted Power Supply (UPS) Room
 - vi. Steam and Water Analyzer (SWAS) Panel Room (Dry Panel)
 - vii. Excitation room
 - viii. AVR room
 - ix. Relay panel room
 - x. Other Office areas like Telephone Exchange Room, Conference Hall, library, Laboratory Rooms etc, if any, on the operating floor
- b. Service Building
 - i. Maintenance Office areas, conference rooms, lecture rooms and any other areas needs Air Conditioning.
 - ii. AC plant control room (in Central AC plant equipment room proposed to be located in ground floor of Service Building)
- c. ESP Control Room.
- d. VFD Control Room (if applicable)
- e. Ash Handling Plant Control Room
- f. DM plant control room, office and Laboratory area.

- g. Switchyard Control Room.
- h. Chemical Laboratory Building.
- i. Coal Handling Plant control room
- j. Any other Local Control Rooms / Cubicles of different Auxiliary Buildings housing Programmable Logic Controllers (PLC) Panels and other Input / Output (I/O) modules
- k. Rooms having the equipment required controlled temperature by nature for their operating feature.
- l. Any other area requiring Air conditioning as per manufacturer's recommendation.

All the buildings described above shall preferably be provided with separate air conditioning systems because they may be far apart from each other.

- 2.02.00 For the Power House Building and the attached Service Building, one Common Central Chilled type Air Conditioning plant shall be provided with individual Air Handling Units / Fan-Coil Units (as applicable) for the Unit Control Room, Control Equipment Room, Shift Charge Engineer's Room, Computer Room, Uninterrupted Power Supply (UPS) Room, Excitation Room, AVR Room, Relay Panel Room, SWAS (Dry Panel) Room, all Laboratory Rooms and other Office areas, Telephone Exchange Room, Conference Hall, and Library etc, if any, on the operating floor.
- 2.03.00 Water Cooled Precision air Conditioners of 3 x 50% capacity shall be provided for the ESP Control room, VFD Control Room (if applicable), AHP Control Room, DM Plant Control Room and its associated office and Laboratory and Chemical Laboratory Building. Condenser cooling water for these Air Conditioners shall be supplied from main plant ACW system through Non-Chemical Water Treatment Device. Provision of a Fresh Air unit consisting of Air Inlet Louver with Bird Screen, Dry panel HDPE filters, Tube Axial Flow Fan with Drive Motor, Volume control damper, Supports and supporting structures etc. shall be provided for each PAC Room.
- 2.04.00 Air Cooled Packaged Units (Precision Type) will be used for air conditioning of the Switch Yard Control room and CHP Control room. Provision of a Fresh Air unit consisting of Air Inlet Louver with Bird Screen, Dry panel HDPE filters, Tube Axial Flow Fan with Drive Motor, Volume control damper, Supports and supporting structures etc. shall be provided for each PAC Room.
- 2.05.00 Air cooled non duct able Split Air Conditioners shall be provided for Rooms / cubicles housing Programmable Logic Controllers (PLC) and other Input / Output (I/O) modules or any other area requiring for Air conditioning. Required no. of AC units of suitable capacity should be selected with 100% units as stand-by for AC areas having 24 hours operation. For AC areas with less than 12 hours operation, stand-by units may be avoided if multiple units are installed.

- 2.06.00 The systems described above are only minimum requirement. Any other area/areas, if felt by the Bidder himself or by the Purchaser/their consultant, or if demanded by the process/equipment should be air conditioned, shall be included in Bidder's scope of work.
- 2.07.00 The foregoing and subsequent clauses specify the equipment/system for general guidance only. Any other equipment and /or materials necessary to ensure safe and satisfactory erection, commissioning and operation of the plant shall be supplied.
- 2.08.00 The air conditioning requirement for different areas are as follows:
- 2.08.01 One Common Central chilled water Air Conditioning system consisting of 2x100% Packaged Screw type Chiller Units associated with 2 x 100 % capacity Chilled water pumps, 2 x 100 % capacity Condenser water pumps , 2 x 100 % capacity Cooling towers and controls & instrumentation to serve the Unit Control room, Control Equipment room, Computer room, UPS room, SWAS (Dry Panel) room and Shift Charge Engineer's room, AVR Room, Excitation Room, Relay Panel Room, Other Office areas, telephone exchange room, Conference Hall, library and Laboratory etc, if any, located in the Power House building and all the floors of the attached Service Building.
- Clarified water shall be used as the make-up to cooling towers. This condenser cooling water will be treated through the Non-Chemical Water Softening Equipment installed in the common header of Condenser water pump outlets.
- 2.08.02 Unit Control Room & Shift Charge Engineer's Room, Computer Room, Control Equipment Room and UPS room in the Control Building will be served by at least 2 nos. each of 50% capacity AHUs located in the AHU Room.
- For SWAS (Dry Panel) Room and Shift Charge Engineer's Room, AVR Room, Excitation Room, Relay Panel Room, Other Office areas, Telephone Exchange Room, Conference Hall, Library and Laboratory etc, if any, and the attached Service Building individual AHUs/ Fan Coil Units shall be provided. Each floor of Service Building shall have separate AHUs. For each room / area at least 2 nos. AHU/FCU shall be provided.
- However, the combination of areas to be served by AHUs / FCUs will depend upon the actual layout when the building drawings will be finalized.
- 2.08.03 1 x 100% capacity Fresh Air Unit consisting of Air Inlet Louver with Bird Screen, Dry panel HDPE filters, Tube Axial Flow Fan with Drive Motor, Volume control damper, Supports and supporting structures etc. shall be provided for each AHU Room serving critical areas like Control Room, Control Equipment Room, UPS room, AVR Room, Excitation Room, Relay Panel Room, Telephone Exchange Room, Laboratory, etc.
- For other non-critical areas like Office areas, Conference Hall, Library, various floors of Service Building fresh air will be inducted in the AHU room through the wall mounted rain protection cowl with bird screen and a volume control damper.

1 x 100% capacity Fresh Air Unit consisting of Air Inlet Louver with Bird Screen, Dry panel HDPE filters, Tube Axial Flow Fan with Drive Motor, Volume control damper, Supports and supporting structures etc. shall be provided for each PAC Room serving critical areas like ESP Control Room, VFD Control Room (if applicable), Ash Handling Plant Control Room, Chemical Laboratory Building, DM Plant Control Room, Office and Laboratory area, Switchyard Control Room and Coal Handling Plant Control Room etc.

Fresh air for small areas like SWAS room, AC plant control room, small office and control rooms fresh air will be inducted through door opening.

2.08.04 1 x 100 % capacity Electrode Type Humidifier with associated controls and accessories shall be provided in each AHU room serving critical areas of Power House Building.

2.08.05 Provision of Duct mounted Electric Strip heater and High Efficiency Filter shall also be kept with the common supply duct from the AHUs serving critical areas like Unit Control Room, Shift Charge Engineer's Room, Computer Room, Control Equipment Room, UPS Room, AVR Room, Excitation Room, Relay Panel Room, telephone exchange room, Laboratory, etc.

Duct mounted Electric Strip heater shall be provided with the common supply duct for non-critical areas like Office, Conference Hall, library, various floors of Service Building etc.

2.08.06 Smoke Evacuation system consisting of smoke exhaust fans with ducting, motorized isolating dampers and rain protection cowl with bird screen shall be located in AHU rooms serving control room and associated areas of Power House building.

2.08.07 Exhaust fans of required capacity & quantity to be provided for Central AC plant equipment room.

3.00.00 **SCOPE OF WORK**

Scope has been defined under subsequent Clauses.

3.01.00 **Central Chilled Water Air Conditioning Plant** (Common for Power House Building and Service Building)

The central chilled water AC plant consists of the following equipment:

3.01.01 Two (2) Nos. (one as running and one as stand-by) Water Cooled Screw Chiller Unit of adequate capacity and each consisting of:

a) One(1) / Two(2) Nos. Screw Compressors (As per Manufacturer's standard).

Type: Rotary Screw type, hermetic/semi- hermetic, directly driven, R-134a duty.

Accessories include suction and discharge shut-off valves, discharge check valve, oil Separator, oil heater, HP, LP, Low oil level cutout, high winding temperature cutout through PTC sensors, Motor overload cutout, liquid Injection system, integrated pressure relief valve, oil service valve, Step less Automatic capacity control arrangement with automatic unloaded starting device, Anti Recycle device, Heater, Setting and Overhauling tools, foundation bolts, vibration isolating device etc.

Adequately sized Induction Motor (for the above compressors) suitable for $415V \pm 10\%$, 3 phase, $50Hz \pm 5\%$ AC. AC Supply.

b) One(1) No. Refrigerant Condenser.

Type :Water cooled, horizontal, shell and tube R-134a duty & capacity to match the above compressor with integrally finned copper tubes with steel shell having adequate surface area to cater to the requirement of the above compressor & to provide sub-cooling by 2 Deg. C at least.

Design fouling factor : Not less than .0002 Hr. Sq. M. $^{\circ}C/Kcal$ (.001 Hr-Sq. ft $^{\circ}F/BTU$).

Heat removal and water flow rate :To be calculated and furnished by be Bidder.

Accessories: Relief valve, vent connection with valve, De-scaling connection, charging connection, water flow switch, drain connection with valve. Thermo-well connections on water side, liquid trap etc.

c) One(1) No. Refrigerant Chiller.

Type : Horizontal shell and tube direct expansion/flooded type R-134a/water duty with copper tube having adequate surface area to provide superheating by 3 Deg.C.

Design fouling factor : Not less than 0.00013 hr-Sq. m. $C/Kcal$ (0.00065 hr-Sq. ft. Deg. F./ BTU).

Heat removal and Water flow rate: To be calculated and furnished by the Bidder.

Accessories: Liquid and water connection provided with thermo-wells, water flow switch and pressure gauge connections.

At least 39 mm thick insulation of Aluminium foil faced Nitrile Rubber /XLPE or equal, with removable type insulated flange cover, water side drain connection with valve in every portion of the chiller isolated by baffle plates.


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- d) Piping & Auxiliaries : Common base frame for compressor, condenser, chiller unit fabricated of M.S. angles, channels etc. anchor bolts, nuts, hot gas piping, cold gas piping, liquid refrigerant piping all of seamless steel or ERW steel pipes, insulation of cold gas piping with minimum 39 mm thick Aluminium foil faced Nitrile Rubber /XLPE or equal liquid valves, muffler if needed, gauges and instrument piping, filters, drier, moisture indicator isolating valves etc. as may be required for safe and trouble free operation. The entire chiller package assembly shall be installed with spring type vibration isolation devices (One set for each chiller unit)

Equipment drain water connection with siphon and valves, fittings etc. up to the nearest drain point with proper insulation shall also be included.

- e) Controls: Electronic expansion valve, solenoid valve in the refrigerant circuit, operating temperature sensor and anti freeze thermostat/ sensor.

Microprocessor based control panel of each chiller unit will provide safety against high & low refrigerant pressure, low oil pressure, freezing of chilled water, overload, winding heating and single phasing and phase reversal of compressor by means of high & low pressure transmitter, oil pressure transmitter, temperature sensors & transmitter, O/L relays, Thermistor relays, etc. and other safety Controls including Over/Under voltage and voltage unbalance protection, over/under current and current unbalance protection and others as per manufacturer's standard.

It will also provide capacity control by sensing low chilled water return temperature through operating temperature sensor and motorized sliding valve. Other safety devices like flow switches for the condensers and chillers, compressor unloaded starting device shall also be provided through Microprocessor based control panel. (One set for each chiller). Such Microprocessor based Control Panel shall be provided with 20% extra properly wired I/O units.

- f) Oil and Refrigerant: First charge of refrigerant R-134a and oil for the above chiller units.

- 3.01.02 Condenser cooling water piping of MS ERW (heavy grade) complete with valves, fittings, hangers / supports. between cooling towers and condensers (of Screw Chiller Units) including the condenser cooling water pumps complete with valves, bends, strainers, fittings, instruments, hangers and supports etc. Equipment drain water connection and valves, fittings etc. up to the nearest drain point shall also be included. A single line diagram in this connection is to be furnished by the Bidder.

- 3.01.03 Chilled water piping connecting the chillers(of Screw Chiller Units), chilled water pumps and cooling coils of air handling units / FCUs and expansion tank, complete with valves, bends, strainers, fittings, instruments, hangers and supports, insulation etc. A single line diagram in this connection is to be furnished by the Bidder.

The insulation shall be at least 39mm thick Aluminium foil faced Nitrile Rubber /XLPE or equal (Refer elsewhere for detailed specification of insulation). For Chilled water drain pipes the insulation thickness shall be at least 26 mm.

- 3.01.04 Make up water piping of medium class GI complete with fittings, hangers / supports from Make-up Water tank through booster pumps (1R+1S) to various points of consumption like cooling tower sumps, expansion tank and Humidifiers.

- 3.01.05 Two (2) Nos. (1 working + 1 Stand-by) Condenser Cooling Water Pumps to meet the requirement of the Central Chilled Water plant.

Type : Centrifugal, horizontally split casing / end suction type, single stage directly coupled to electric motor and mounted on a common base frame.

Speed : Preferably not more than 1500 rpm.

Capacity and Head : To be calculated and furnished by the Bidder.

Duty : Continuously running.

Accessories : Pressure gauges at suction and discharge, isolating valves, all integral piping, required for sealing, cooling etc. strainers, check valves, flexible coupling guard, foundation bolts and nuts etc. and other standard accessories as may be necessary for successful operation. Vibration isolators shall also be supplied. Condenser water pumps shall be provided with mechanical seals.

Motor for the above : Adequately sized TEFC, squirrel cage induction motor, suitable for 415 V $\pm$ 10%, 3 pH, 50 Hz $\pm$ 5% supply.

- 3.01.06 Two (2) Nos. (1 working + 1 stand-by) Chilled Water Circulating Pumps for all areas.

Type : Centrifugal, horizontally split casing / end suction type, single stage directly coupled to electric motor and mounted on a common base frame.

Speed : Preferably not more than 1500 rpm.

Capacity and Head : To be calculated and furnished by the Bidder.

Accessories : Pressure gauges at suction and discharge, isolating valves, all integral piping required for sealing, cooling etc. strainers, check valves, flexible coupling guard, foundation bolts and nuts, complete insulation with minimum 39 mm thick Nitrile Rubber /XLPE or equal with 24G aluminium sheet cladding. For the pumps, vibration isolators shall also be supplied. Chilled water pumps shall be provided with mechanical seals.

Duty : Continuously running.

Adequately sized, TEFC squirrel cage induction motor suitable for 415 V $\pm$ 10%, 3 Phase, 50 Hz $\pm$ 5% supply for the above.

- 3.01.07 Two (2) Nos. (1 working + 1 stand-by) Cooling Tower Induced draft cross/counter flow type to meet the requirement of the Central Chilled water plant. Design Wet bulb temp. will be 27.6 $^{\circ}$ C with a approach (Maximum) of 4.0 $^{\circ}$ C.

Construction of various components will be as under:

Casing	:	FRP
Louver	:	FRP
Fill	:	PVC
Drift eliminator	:	PVC
Strainer	:	Brass wire mesh
Headers and pipe connection	:	G.I.
Basin	:	R.C.C./FRP
Nuts and Bolts etc.	:	Suitable corrosion resistant material i.e. G.I. or cadmium plated.

Accessories include supports, supporting structure, make-up water piping with float valve, drain connection with siphon and valve, over flow and quick fill connections etc.

- 3.01.08 Expansion Tank

The expansion tank shall be made of G.I or FRP and shall be of adequate thickness & suitably reinforced. It shall be complete with make-up connection with float valve, quick fill connection, overflow connection and drain connection with valve. The tank shall be provided with level gauge glass and shall be completely insulated with 6 mm thick Aluminium foil faced Nitrile Rubber /XLPE or equal. The capacity shall be selected based on 1.2% of circulated chilled water capacity. Filtered water shall be supplied as make-up.

- 3.01.09 Make-up water Tank

The Make-up water tank shall be made of G.I or FRP and shall be of adequate thickness & suitably reinforced. It shall be complete with make-up connection with float valve, quick fill connection, overflow connection and drain connection with valve. The tank shall be provided with level gauge glass. This tank will supply make-up water to Cooling towers, Expansion tank and

- humidifiers. The tank size is to be designed based on capacity to hold water for 15 minutes of make-up water requirement for above.
- 3.01.10 Two (2) Nos. (1R+ 1S) Make-up Water Booster pumps.
- Mono block type centrifugal pump to supply make-up water from the Make-up water tank to the Cooling towers, Expansion tank and humidifiers, each complete with drive motor, common base plate, isolating valves, non return valve etc.
- 3.01.11 One(1) No. on line Non-chemical water treatment equipment to suit the common condenser water header. The equipment shall be complete with flanges at ends and supports.
- 3.02.00 **Air Handling Units/Fan Coil Units with controls**
- Number and individual capacities of Air Handling Units/Fan Coil Units should be calculated and furnished by the Bidder. Each A.H.U. shall consist of the following:
- 3.02.01 DIDW Centrifugal Fan having forward/backward curved blades and belt driven by TEFC squirrel cage Induction motor suitable for AC 415V $\pm$ 10%, 3 Ph, 50 Hz $\pm$ 5% supply shall be provided. M.S. Scroll casing of the fan will be suitably painted.
- Accessories include V-belts with pulleys, belt guard, supporting frame, volume control damper etc.
- NOTE: For small FCUs single phase motors shall be used.
- 3.02.02 1 No. Cooling Coil will be provided in each AHU. The cooling coil will be chilled water circulating type.
- Construction will be seamless copper tubes with aluminium fins, number of fins as per manufacturer's standard but not greater than five (5) per Cm. [thirteen (13) per inch].
- Design fouling factor will be 0.00013 hr-Sq. m.- $^{\circ}$ C/Kcal.
- 3.02.03 Panel type dry HDPE filter having an efficiency of 90% down to 10 micron size particles will be provided. A differential pressure sensor shall be provided across the filters to initiate alarm when the pressure difference across the filters exceeds a pre determined value, warranting cleaning /replacement of filters.
- 3.02.04 AHU will have Double skin G.I casing (Sand witted panel with internal insulation of min. 25mm thick TF quality Expanded polystyrene/ PUF) with inspection facilities, supports made in a 16-G M.S. structure of sectionalized construction with one coat of rust proof anti-corrosive paints followed by two coats of final paint and complete with insulated SS drain pan, insulated drain piping etc. The AHUs shall be cabinet type with Fan section, Coil section and filter section. Adequate space between Filter section and Coil section shall be

kept for maintenance purpose and proper air flow. Fan section also shall have adequate maintenance space all around the fan and motor.

- 3.02.05 One set of operating controls consisting of motorized modulating 3-way mixing valve with cooling coils of AHUs and FCUs with temperature sensor, transmitter and actuator for controlling the flow of chilled water, will be provided. Small FCUs shall have multi-speed motor.

3.03.00 **Fresh Air System**

Fresh air unit for Control room areas and areas served by Precision air conditioners shall consist of a tube axial flow/centrifugal fan with drive motor, inlet louver with bird screen, dry panel HDPE filters, volume control damper, supports, supporting structures etc. 1 x100% capacity Fresh air unit shall be provided in each AHU room / PAC room. A differential pressure sensor shall be provided across each set of filters to initiate alarm when the pressure difference across the filters exceeds a pre determined value, warranting cleaning /replacement of filters.

For Fan coil unit, there shall be provision for suitable arrangement of fresh air intake from the nearest evaporative cooling units.

For Service Building and other non-critical areas, fresh air opening with air inlet louver and a volume control damper shall be provided in the AHU room.

3.04.00 **High Efficiency Filter**

High efficiency filter having an efficiency of 99 % down to 5 microns mounted in supply air duct is to be provided for air conditioning of all control rooms and allied area. A differential pressure sensor shall be provided across the filters to initiate alarm when the pressure difference across the filters exceeds a pre determined value, warranting cleaning /replacement of filters.

3.05.00 **Electrode Type Humidifier**

Electrode humidifier consists of high temperature Polypropylene water tank, electrodes, auto flash cycle activated on demand from the microprocessor based control system with humidity sensor, located in the AHU room for control room areas of Power House building. This Humidifier shall also be complete with make up connection with float valve, overflow connection and drain connection with valve.

3.06.00 **Electric Strip Heaters**

Electric strip heaters will be of adequate capacity mounted in supply air duct with thermostat, humidistat, air stat/safety thermostat and controlling temperature sensor etc. (For winter heating purpose and for monsoon reheat purpose.) for control room areas of Power House building.

Electric strip heaters will be of adequate capacity mounted in supply air duct with thermostat, air stat/safety thermostat and controlling temperature sensor etc. (For winter heating purpose) for various floors of Service Building.

3.07.00 **Smoke Exhaust System**

Smoke Evacuation system consisting of smoke exhaust fan with ducting and motorized isolating dampers with cowl & bird screen shall be located in AHU rooms servicing Control room areas of Power House building. The fan and motor shall be designed to withstand a temperature of 400 Degree C for 2 hours.

3.08.00 **Duct Work**

Duct work includes:

- a) G. I. Duct having zinc deposition of at least 180 gm/m².
- b) Damper with control arrangement at each branch off and wherever necessary.
- c) All supply & return air grilles and diffusers made of extruded aluminum powder coated and complete with volume control dampers (for SA grilles/diffusers only) and supporting frames.
- d) Flexible connections of rubberized canvas.
- e) Hangers and supports.
- f) Sealing compound and jointing gasket for ducts.
- g) 13 mm thick Aluminium foil faced Nitrile Rubber /XLPE or equal or equivalent thermal insulation for the entire air conditioning ducting.
- h) Acoustic insulation of 25 mm thick open cell erosion resistant Nitrile Rubber foam of density min. 140 Kg/CuM provided in the ducting up to a length of 6 M from the Air Handling Unit / Precision Air Conditioner outlet.
- i) Motorized fire damper with sensors, control etc. at strategic locations, as required. Provision of manual overriding operation through latch shall also be kept with the Motorized Fire Damper.

3.09.00 **Water Cooled Precision Air Conditioners**

(Applicable for ESP Control room, VFD Control Room (if applicable), AHP Control Room, Chemical Laboratory Building and DM Plant Control Room and its associated Office and Laboratory)

Water Cooled Precision Air Conditioners shall be complete with scroll compressors (suitable for R-410/407c refrigerant) and water cooled shell and tube condensers, interconnecting refrigerant piping (duly insulated) between condensers and PAC units, evaporator fans with highly efficient EC motors and their controls, high efficiency filters, cooling coils with electronic expansion valve, electrode type humidifiers with controls, electric strip heaters, thermally and acoustically lined powder coated MS casing, insulated SS drain pan, insulated

drain piping, and built-in microprocessor based control panel.

Such Air Conditioners will be associated with air distribution system consisting of a GI duct - work as elaborated above, Non Chemical Water Treatment Equipment at the inlet to the condensers of PAC. Condenser cooling water will be fed to the condenser from the Plant ACW system.

3x 50% capacity Precision AC Units are to be provided each for each PAC room.

Provision of introducing fresh air into the PAC unit room shall be kept through Fresh Air Unit as described earlier.

3.10.00 Air Cooled Precision Air Conditioners

(Applicable for Switch Yard Control room and CHP Control room)

Air Cooled Precision Air Conditioners shall be complete with scroll compressors (suitable for R-407C / 410A refrigerant) and remote air cooled condensers, interconnecting refrigerant piping (duly insulated) between outdoor condensers and indoor PAC units, evaporator fans with highly efficient EC motors and their controls, high efficiency filters, cooling coils with electronic expansion valve, insulated SS drain pan electrode type humidifiers with controls, electric strip heaters and built-in microprocessor based control panel thermally and acoustically lined powder coated MS casing and insulated drain piping. Such Air Conditioners will be associated with air distribution system consisting of a GI duct - work as elaborated above.

3x 50% capacity Precision AC Units are to be provided each for each PAC room.

Provision of introducing fresh air into the PAC Unit Room shall be kept through Fresh air unit as described earlier.

3.11.00 Air Cooled Non Duct-able Split Air Conditioners

(Applicable for rooms/cubicles housing PLC and other I/O units, computer room and any other area requiring air conditioning)

Air Cooled Non Duct-able Split Air Conditioners shall be complete with hermetically sealed rotary compressors and air cooled condensers in the outdoor units with powder coated GI casing, built-in electrical items & supports and Indoor units housing dry panel type HDPE filters, cooling coils, evaporator fans with two speed drive motors, all encased in powder coated GI casings with swiveling type supply air grilles and decorative RA grilles and interconnecting refrigerant piping (duly insulated) between outdoor and indoor units and insulated drain piping, microprocessor based cordless remote control panel and 240V, single phase MCB with connecting cable for each split unit.

Required no. of suitable capacity should be selected with 100% units as stand-by for all rooms/ cubicles housing PLC and other I/O units/ computer room running for 24 hours.

For AC areas with less than 12 hours operation, stand-by units may be avoided if multiple units are installed.

3.12.00 **Electrical Work**

3.12.01 **One (1) 415 V Motor Control Centre (MCC)** for operation and control of the complete Central AC system required for the Power House Building and the associated Service Building. The MCC be shall be located in the central Air-Conditioning Plant room.

Each MCC shall be fed by 2 x 100% incoming feeders, which shall be located at either end of the panel.

3.12.02 **One (1) no. Local Starter Panel (LSP)** for each AHU room of Power House Building and attached Service Building. This LSP will house In-coming MCB, outgoing starter for all drives located in AHU room and MCB for heaters, humidifiers and FCUs.

3.12.03 **One (1) 415V Power Distribution Board (PDB)** each for supplying power to the PAC units of each Auxiliary Building.

Each PDB shall be fed by 2 x 100% incoming feeders, which shall be located at either end of the panel.

3.12.04 Non Duct-able Split units shall be fed from local distribution board / nearest power source available in the respective building.

3.12.05 All the Electrical items as described above shall be as per relevant volume of the technical specification on electrical work.

3.12.06 DDC Based Control Panel

- I. Control, monitoring, operating and safety controls & interlocks, indication and audio-visual annunciation for all AC equipment of the Central Chilled Water Plant and AHU rooms shall be activated from central DDC based Control Panel located in the AC plant control room.
- II. Power shall be fed to this DDC Panel from the MCC located in the Central AC plant room. This DDC panel shall be interfaced with the MCC, Individual Microprocessor based Control panels of Chillers and LSPs located in AHU rooms.
- III. This DDC panel shall be associated with two nos. Workstations (Engineering & Operating).
- IV. The DDC System shall consist of:
 - a) One (1) no. DDC panel housing Direct Digital Controllers for Central Air Conditioning System. The DDC panel shall be suitable for HMI interfacing directly with sensors, actuators and environmental delivery systems (i.e., all component equipment and accessories of AC system), controls and monitoring for the central AC System. This Control system along with one work station shall be complete with necessary software & Licenses (OS cum ES) for control

and monitoring of the Central AC System and generation of alarm list, report etc.

- b) One (1) no work station complete with suitable Central Processing Unit (CPU) Key Board, Mouse and Video Display Unit (VDU) with 21 inches monitor.
- c) Necessary battery back up for RAM for 24 hours continuous operation during power failure and necessary UPS and battery charger with minimum 30 minutes back up.
- d) Necessary UPS Battery & Charger for DDC System back up shall be provided in the AC Plant Control Room.
- e) Necessary interface hardware and software for interconnection with other system for two-way data transfer for information exchange. The data format, the exact number of points etc. shall be finalized during detailed engineering stage.
- f) All other necessary hard wares to make the system complete and functional.
- g) One Common Hooter for audio annunciation of any malfunction of AC equipment and systems.
- h) System earthing and panel earthing of the DDC Panel.
- i) The DDC shall have inbuilt PID function's for precise control of the process parameters.
- j) The user friendly programming shall be done via Windows software.
- k) Interlock list for equipment should be incorporated in the operator station.
- l) Alarm List (Process & System), Event List , Different level of security.
- m) The DDC Control system and its HMI shall have necessary Graphic user interface for display of the processes with indication of devices and instruments. In case of alarms the alarm indication window will be displayed on the screen to attract the attention of the operator and generate output for audio-visual annunciation.
- n) Various controls and annunciations to be provided in DDC panel shall be as per clause no. 4.00.00: Control Philosophy.

3.12.07 Local Push Button Stations

Local Push Button Stations shall be provided for each drive motor and equipment (Cooling Tower Fan Motors, FCUs and Make-up Water Booster Pump Motors etc.), suitably located near drives and equipment of each AC system. LPBS shall consist of one no. emergency Red Stop P.B (pressed to latch and turn to release type) for each drive.

Local Push Button Stations shall be as per the relevant Volume of the electrical specification.

For Other detail VOLUME : II-F shall be referred to.

3.12.08 Local Distribution Board (240V)

Local Distribution Boards containing Switch / MCB for Non Duct-able Split Air Conditioners detail specification VOLUME : II-F shall be referred to.

3.12.09 Drive Motors

- i) Motors shall be supplied with mounting and coupling hard wares such as base plate, coupling, coupling guard, anchor bolts and nuts, all hardware etc.
- ii) Design ambient temperature of all motors for air conditioning system shall be 50 °C.
- iii) Motors shall have class F insulation but the temperature rise shall be limited to that of class B over an ambient temperature of 50 °C.
- iv) The motor nameplate kilowatt rating multiplied by the motor nameplate service factor shall be at least 15% greater than the driven equipment operating range maximum brake kilowatt.
- v) Motors rated 30 KW and above shall be provided with space heater suitable for 240 V, 50 Hz, 1 Ph. AC.
- vi) Motors rated below 250 watts shall be suitable for 240 V, 50 Hz, 1 Ph. AC. Motors rated 250 watts and up to 160 KW shall be suitable for 415V $\pm$ 10%, 3-Phase, 50Hz $\pm$ 5% AC.
- vii) Motors rated above 110 KW shall be fed by Air Circuit Breaker and others of lower rating shall be fed by MCB/MCCB.
- viii) All motor enclosures shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather proof construction.
- ix) All drive motors shall be as per relevant Volume of the Electrical Specification.

3.12.10 All Power, Control and Instrumentation cabling as required and conforming to the requirement of relevant Volume of Electrical Specification.

3.12.11 Grounding of all electrical items as per relevant Volume of Electrical Specification.

3.13.00 Suspended Ceiling work with supporting grids, hangers etc. for all the air conditioned areas. The Suspended Ceiling shall be complete with 12mm thick GYPSUM board at various elevations including supplying, fixing snap grid

systems of approved manufacturer with 40 mm X 50 mm cross tees and 40 mm X 50 mm end channels including MS hangers, cleats, supports, turn-

buckles, ties placed around 1200 mm (Max.) centre to centre for forming frame work to support snap grid systems and lighting fixtures including all ancillary work at site like providing of various cut outs, holes, recess, trap door (removable panels), wherever shown, welding to reinforcement to hangers, if required, grouting of hangers and complete with all finish in super decorating manner, providing openings for lighting and air conditioning fixtures including painting of all structural with two coats of approved primer and final paint and also complete with all materials as per working drawings, and direction of engineers.

3.14.00 Under-deck Insulation work for all the air conditioned areas. Roofs of AC spaces are insulated with 25 mm thick EPS (Under-deck) for roofs not exposed to Sun and 50mm thick EPS (Under-deck) for roofs exposed to Sun.

3.15.00 **Supply, Erection, Testing and Commissioning**

3.15.01 Erection, testing and commissioning of all the equipment and accessories mentioned herein above including supply of all grouting pieces, all matching flanges, connecting flanges, valves and other fittings bolts, nuts, gaskets and supporting arrangement as required, are included in the scope of work.

3.15.02 Base plate and foundation plates including anchor bolts, nuts, loose fittings etc. for equipment and as would be necessary for erection and complete anchoring of steel materials for the pipes, hangers and supports for water chilling unit and other equipment, are to be supplied.

3.15.03 At least 39 mm thick Aluminium foil faced Nitrile rubber / XLPE insulation on refrigerant piping as required for the Precision type PAC units and 26 mm thick similar insulation for Non Duct-able Split units.

3.15.04 Supply, erection, testing and commissioning of all electrical drives and equipment mentioned herein above including supply erection, testing and commissioning of cables, cable trays, grounding of all drives and equipment for each AC plant and system as required for efficient and trouble-free operation and successful commercial operation, are included in the scope of work.

Erection, testing and commissioning of electrical drive motors and equipment shall be as per relevant volume of the specification.

3.16.00 **Consumables**

All consumables such as grease and lubricating oil for one year's trouble free operation after handing over, are to be included.

3.17.00 **Spare parts**

Supply of recommended spare parts for three years trouble free operation and maintenance is to be included.

3.18.00 **Special tools and tackles**

Supply of special tools and tackles including tool box required for operation, maintenance and overhauling of the system is to be done.

3.19.00 **Documents**

Drawing, data, characteristic curves and instruction manuals for the equipment and system as detailed herein after and as described in the relevant volume of the specification are required.

3.20.00 **Training of Purchaser's Personnel**

Contractor is to arrange for training of purchaser's personnel for operation and maintenance of the plant and equipment supplied.

3.21.00 **General**

Above clauses specify the equipment for general guidance only. Any other equipment and/or materials necessary to ensure safe and satisfactory erection, commissioning and operation of the plant shall be supplied.

4.00.00 **CONTROL PHILOSOPHY**

4.01.00 **Chilled Water Air Conditioning System**

The chilled water plant shall operate with 2 x 100% capacity Packaged Screw Chiller unit (1R+1S), 2x100% capacity (One no. working and one no. Standby), condenser water (CW) pumps, 1x100% capacity (One no. working and one no. Standby), chilled water (CHW) pumps, 2x100% capacity (One no. working and one no. Standby) induced draft-cooling towers.

All the equipment of this system shall be operated from the DDC system work stations located in the AC plant room. Furthermore cooling tower fans, make up Water Booster Pumps and FCUs shall also be operated from their individual local Push-button stations.

One no. Local starter Panel shall be installed in each AHU room which will feed power to all the AHU fans, motors of 3-way mixing valves of AHUs, Fresh air fans (wherever applicable), Smoke Exhaust fans (wherever applicable) and their motorized isolating dampers, Fire damper motors, Electric heaters and Humidifiers and FCUs of SWAS rooms, UPS Room. This equipment located in each AHU room and SWAS/ UPS Room shall be operated and controlled from the workstations through DDC system located in the AC Plant Room as well as from these Local Starter Panels.

FCU/s for AC Plant Control room shall be operated from the workstations through DDC system and from their local Push-Button stations.

The Packaged Screw Chilling units shall incorporate microprocessor based control panel, which will also be interfaced with the DDC system.

The Packaged Screw Chilling units can be started only when its associated cooling tower fans, condenser & chilled water pumps are in operation.

All the drives of the AC system shall be manually started / restarted through DDC from the work stations after any trip.

The chilled water system shall be provided with the following safety & operating controls:

(i) Operating Control:

Room temperature control with the help of modulating 3-way chilled water flow regulating valve with the cooling coil of AHUs / FCUs through the central DDC system, getting sense from the temperature sensor and associated transmitter placed in the return air path.

Chilled water temperature control based on the room load with the help of operating temperature sensor and controlling through compressor's automatic unloading mechanism for screw chillers through the built-in Microprocessor based control panel of Packaged Screw Chiller. This control shall also be possible through the central DDC system.

Room RH control with the help of humidifiers (if required) & duct mounted re-heaters through the central DDC system getting sense from the RH & Temperature sensors and their associated transmitters placed in the return air path inside AHU rooms.

(ii) Safety Control:

The chilled water system shall be incorporated with the following safety controls and interlocks:

High discharge pressure cutout (HP).

Low suction pressure cutout (LP).

Low oil level cutout

High winding temperature cutout
through PTC sensors

Low chilled water temperature cutout by anti-freeze thermostat /temperature sensor for Screw chiller.

Cutout due to low flow of chilled water & condenser water by flow switches.

Cutout due to overload of all drive motors.

High air temperature cutout by safety thermostat / temperature sensor for duct mounted electric heaters.

Low cooling tower sump water level cutout for CW pumps. (Alarm for low water level in expansion tank & humidifier as applicable shall be provided).

Stopping of AHU fans in case of fire in the respective zone through the central DDC system.

Short circuit protection.

Closing of fire dampers at the air supply duct from AHUs in case of fire with the sense from room mounted fire/smoke detector through zonal fire panel and the DDC system.

Heater for compressors, which will be energized during compressor idling time. This safety control shall be actuated through the built-in Microprocessor based control panel of each Screw chiller.

Safety controls of Screw chillers will also include Over/Under voltage and voltage unbalance protection, Single phase & Phase reversal preventor, over/under current and current unbalance protection and others as per manufacturer's standard.

(iii) Interlocks:

The system components shall be interlocked with one another in the following way:

The Screw Compressor shall not start unless:

At least one cooling tower fan is running.

At least one condenser water pump is running.

At least one chilled water pump is running.

The duct mounted electric strip heater shall not be energized unless the respective AHU fans are running.

All the above Interlocking shall be actuated through the DDC Panel.

On-Off-trip status for all the drives, electric heaters & humidifiers (if required) shall be available at the work stations of the DDC Panel located in the respective AC plant rooms.

Motors of fire dampers provided in supply air duct of AHU shall remain energized in normal condition to effect opening of dampers. In the event of fire, the motors of fire dampers will be de-energized and the damper will close due to spring action, the relevant AHU fan motors will be tripped at the same time. These dampers shall be operated through the DDC Panel getting signal from relevant duct mounted smoke detectors / fire alarm panel.

Provision for one common audio annunciation for any kind of malfunctioning in AC plant shall be kept through a hooter located in the AC Plant Control Room and suitably interfaced with the DDC Panel.

The control system shall comprise central DDC Panels with two workstations located in the AC Plant control room.

The basic function of the system is as follows: -

To closely control and monitor inside temperature and humidity condition inside the air-conditioned spaces.

To optimize / minimize energy consumption by automated operation.

To provide centralized monitoring and control for various mechanical facilities including sequential start / stop of the whole AC system.

To generate maintenance data and alarms.

To maintain records of plant operation.

Programmed start / stop of individual AHU as per operating requirements and for maintaining the room temperature / RH by controlling the 3 way mixing valves at chilled water line, humidifier and duct heater.

Programmed start / stop of individual FCU as per operating requirements and for maintaining the room temperature by controlling the 3 way mixing valves at chilled water line.

Safe and reliable operation, supervision & control, alarm & event management and optimization, maintenance management of the entire AC system shall be accomplished with the DDC system.

The DDC system shall be interfaced with:

The Air Conditioning MCC.

The Microprocessor based control panels of Screw Chiller.

The LSPs located in each AHU rooms.

The Temperature and RH sensors and their associated transmitters located in the AHU rooms.

The Temperature sensors located in the rooms served by FCUs.

The zonal fire panels/ duct mounted smoke detectors.

The two work stations and the Hooter.

4.02.00 **Air Conditioning System with Water-Cooled Precision Air Conditioner**

This system will operate round the clock for ESP Control Rooms, VFD Control Room (if applicable), Ash Handling Plant Control room, DM Plant Control room with associated office and Laboratory.

Water Cooled Precision Air Conditioners of 3x50% (Two nos. working and one no. Standby) capacity shall be provided for ESP Control Rooms, VFD Control Room (if applicable), Ash Handling Plant Control room, DM Plant Control room with associated office and Laboratory.

Condenser cooling water for the Precision Air Conditioners shall be supplied directly from the ACW system.

The Precision Air Conditioners shall be operated from the respective unit mounted microprocessor based control console.

(i) Operating Control

The Precision Air Conditioners shall have following operating controls:

- ON / OFF thermostatic control of the compressor of Precision Air Conditioners to maintain the desired room temperature.
- Superheat control by means of electronic expansion valve, wherever applicable.
- Room RH control (wherever required) with the help of humidifier & heater installed within AC units getting sense from the humidistat placed in the return air path.

(ii) Safety Control

The compressor of each Precision Air Conditioner shall be incorporated with the following safety controls and interlocks:

- High refrigerant pressure cutout.
- Low refrigerant pressure cutout.
- Low Oil Pressure Cut out (if applicable).
- Cutout due to overload of all drive motors.
- Stopping of evaporator fans in case of fire in the respective zone.
- Closing of fire dampers at the supply duct from Precision Air Conditioners in case of fire with the sense from duct/room mounted fire/smoke detector through zonal fire panel.

- Low condenser water flow cutout.

(iii) Interlocks

The system components shall be interlocked with one another in the following way:

The compressor shall not start unless:

- a) Condenser water flow is low.
- b) The evaporator fans are running.

The electric strip heater shall not be energized unless the respective evaporator fans are running. The Strip heaters will trip with the help of safety thermostat in case the temperature of air at the downstream side of the heaters exceeds a pre-determined value.

On-Off-trip indications for all the drives & electric heaters shall be provided at the unit mounted microprocessor based control console.

4.03.00 **Air Conditioning System With Air-Cooled Precision Air Conditioner**

This system will operate round the clock for Switch Yard Control room and Coal Handling Plant Control Room.

Air Cooled Precision Air Conditioners of 3x50% (Two nos. working and one no. Standby) capacity shall be provided for Switch Yard Control room and Coal Handling Plant Control Room.

The Precision Air Conditioners shall be operated from the respective unit mounted microprocessor based control console.

(i) Operating Control

The Precision Air Conditioners shall have following operating controls:

- ON / OFF thermostatic control of the compressor of Precision Air Conditioners to maintain the desired room temperature.
- Superheat control by means of electronic expansion valve, wherever applicable.
- Room RH control (wherever required) with the help of humidifier & heater installed within AC units getting sense from the humidistat placed in the return air path.

(ii) Safety Control

The compressor of each Precision Air Conditioner shall be incorporated with the following safety controls and interlocks:

- High refrigerant pressure cutout.
- Low refrigerant pressure cutout.
- Low Oil Pressure Cut out (if applicable).
- Cutout due to overload of all drive motors.
- Stopping of evaporator fans in case of fire in the respective zone.
- Closing of fire dampers at the supply duct from Precision Air Conditioners in case of fire with the sense from duct/room mounted fire/smoke detector through zonal fire panel.

(iii) Interlocks

The system components shall be interlocked with one another in the following way:

The compressor shall not start unless:

- a) The condenser fans are running.
- b) The evaporator fans are running.

The electric strip heater shall not be energized unless the respective evaporator fans are running. The Strip heaters will trip with the help of safety thermostat in case the temperature of air at the downstream side of the heaters exceeds a pre-determined value.

On-Off-trip indications for all the drives & electric heaters shall be provided at the unit mounted microprocessor based control console.

4.04.00 **Non Duct Able Split Air Conditioners**

Non-duct able Split air-conditioners will be controlled from the unit mounted Control panel or from the cordless hand operated remote.

5.00.00 **DESIGN CRITERIA**

5.01.00 The design outside conditions are taken from Meteorological Station at Khammam nearest to Kothagudem Thermal Power Station area. For designing of the equipment, outdoor conditions shall be considered as follows:

Outdoor design condition	:	Summer	: 42.6 Deg. C (DB), 26.6 Deg. C (WB)
		Monsoon	: 30.9 Deg. C (DB), 25.8 Deg. C (WB)
		Winter	: 20.8 Deg. C (DB),

Inside design condition : 22.0 Deg. C $\pm$ 1 Deg. C DB & RH 55 % $\pm$ 5% for critical areas like control room, control equipment rooms, computer room, UPS rooms, AVR rooms etc.

24.0 Deg. C $\pm$ 1 Deg. C DB & RH not exceeding 60% for the non-critical areas like offices, conference room, SWAS room, etc. and the areas served by split air conditioners.

For service building the inside conditions shall be 24.0 Deg. C $\pm$ 1 Deg. C DB & RH not exceeding 60% in all seasons except winter. In winter a DB temperature of 22.0 Deg. C shall be maintained.

Any equipment/process demanding any other (less) temperature shall be provided with.

Floor area : As per actual layout

Roof area : As per actual layout

Glass area : As per actual layout. All windows in the Air Conditioned shall be provided with light coloured Venetian blind

Lighting load : 21.4 Watt/sq.m (or actual) for all areas except shift charge engineer's room & service building where 16 watt per sq.m (or actual) shall be considered.

Occupancy : One (1) person in 12 sq.m (or actual)

Equipment/Panel load : As actual.

Solar load : Solar and transmission load through walls, roofs, doors, windows, glazing, floors etc. should be considered.

Ventilation Air : Fresh air at the rate of 1.5 air changes per hour for the control rooms and 1 air change per hour for office areas or at least 34 Cu. M/Hr. per person, whichever is higher, should be considered to achieve pressurization of air conditioned space and to meet the ventilation requirement of occupants.


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Other loads : Heat load due to AHU fan motor, duct friction etc. shall be considered while finding total heat load.

Plant sizing : Plant sizing is to be done by allowing 5% margin on total sensible and latent heat calculated on the basis of above design considerations. An overall margin of 10% on calculated cooling load shall be considered in selecting Plant capacity.

All Condenser cooling water pumps and chilled water pumps, AHUS and FCUS shall have further, 10% margin on their flow capacities.

Insulation : Roof over AC space exposed to sun will be provided with 50 mm thick expanded polystyrene or equivalent. Roof over AC spaces not exposed to sun will be provided with similar insulation of 25mm thickness.

5.02.00 Individual air handling equipment shall be provided for individual facilities. Chilled water flow control valve (3-way), strip heater and electrode humidifier are provided for maintaining inside conditions.

5.03.00 All water piping for the make-up at cooling tower sump, Electrode humidifiers, Expansion tank and Make-up water tank etc. shall be provided by the bidder. Such make-up water piping shall be taken from the nearest clarified water header.

5.04.00 Electric power supply will be 415V $\pm$ 10%, 3 phase, 50 Hz. $\pm$ 5% A C.

5.05.00 The basic proposal by the bidder shall be for equipment strictly according to the technical specification. The location of air conditioning equipment, layout of ducting, piping etc. shall be designed by the bidder and approved by the Consultants/Owner.

5.06.00 The bidder shall satisfy himself regarding the refrigerating capacity required for maintaining the end conditions inside AC spaces before submitting the offer. For this purpose, the basis of computing air-conditioning load mentioned earlier is to be referred. The bidder shall have to guarantee the end conditions mentioned earlier.

5.07.00 **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.
AR1-450-6	:	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.
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 upto 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 No. 210	:	Standard code of testing centrifugal and axial flow fans
IS-2825	:	Code of practice for welding mild steel
IS-2676	:	Dimensions for wrought aluminum and aluminum alloy sheets and strips.

ASHRAE Code : for various filter

IS-655 : Specification for metal air ducts

BS-4735 : Horizontal Burning for XLPE insulation

BS- 4370 Part-1 : Dimensional Stability for XLPE Insulation

ASTM D 1056 : Water Absorption for XLPE Insulation

Pump design and testing should correspond to the procedure mentioned in IS-1520.

5.08.00 The refrigerant for Split units shall be R-22 as per ARI designation.

5.09.00 For requirements of materials of construction, 5.00.00 of this section shall be referred to.

5.10.00 **Special Note**

In case any discrepancy is found between requirements of this section and those mentioned in other sections, stipulations of this section shall prevail.

6.00.00 **DESIGN, CONSTRUCTIONAL AND OTHER REQUIREMENT**

6.01.00 **General Instruction to the Tenderer**

6.01.01 The Tenderer shall refer only to those of the following clauses which are applicable for this particular project as detailed in clause 1.00.00 and 2.00.00 of this specification. The clauses which are not applicable for this project shall be ignored.

6.02.00 **General Design, Constructional and other Requirement**

6.02.01 All the equipment shall be capable of withstanding the stresses which may be experienced during normal operation and test.

6.02.02 All the equipment shall be designed to permit inter-changeability of parts and ease of access during inspection, maintenance, installation and repair of various parts.

6.02.03 All parts subject to substantial temperature changes shall be designed and supported such as to permit free expansion or contraction without resulting in leakages, harmful distortion, misalignment or play.

6.02.04 Proposals for repair or any similar operations involving the plugging, welding, boring or addition of metal to the original castings shall be submitted to the Purchaser/Consulting Engineer and approval shall be received before any such

- work is carried out. Drawing showing details and locations of such modifications shall be submitted to the Purchaser/Consulting Engineer for his records.
- 6.02.05 All equipment shall be heavy duty type suitable for installation in heavy industries and for long period of uninterrupted service.
- 6.02.06 All materials used shall conform to the specification and shall be new and first class in all respects.
- 5.02.07 Anchor bolts, nuts and seating steel work shall be supplied with the equipment. Only hexagonal nuts shall be used for holding down the equipment, with proper lock nuts. All bolt holes shall be spot faced for nuts. In specific cases where not necessary, spot facing may be omitted.
- 6.02.08 Casting and welding shall conform to their respective specifications and shall be free from flaws and objectionable imperfections, machined true and in a workmanlike manner.
- 6.02.09 The separate pieces of equipment shall be marked with unit number. The assembly drawings shall indicate part number of each equipment and unit number for easy correlation.
- 6.02.10 Coupling guards and belt guards shall be furnished as applicable.
- 6.02.11 All equipment, ducts, pipes, controls etc. shall be fully treated against corrosion and sealed against moisture, sand and dust ingress.
- 6.02.12 All plant including ducts and pipes as well as machines shall be vibration isolated, or otherwise treated so that :
- No excessive vibration is felt in the floors or walls of the rooms served by any machine.
 - The mechanically induced vibration levels in floors, walls and ceilings of rooms are sufficiently small as to limit the radiation of the sound level to the rooms within acceptable levels.
- 6.03.00 **Packaged Screw Chillers**
- A. Refrigerant Compressors (Twin Screw Type)
- I. The compressor may be designed either for direct or for indirect drive.
 - II. The compressor assembly shall be adequately designed for minimum vibration and noise disturbances.
 - III. The shaft seal shall be of proven design.
 - IV. All safety devices against high-pressure refrigerant, low-pressure refrigerant and low oil pressure shall be provided, High winding temperature through PTC sensor. The compressor units must be provided with oil pressure regulator.

- V. The horsepower of the compressor motor shall be sized for 115% of maximum rated power required for the unit including the drive loss.
- VI. The compressors shall be provided with built-in-unloaded starting device. The compressor shall have automatic capacity control device preferably built-in-type to match reduced refrigeration load.
- VII. Capacity control must be achieved by use of slide valve, which provides fully modulating capacity control from 100% to 10% (20%, at least) of full load. The slide valve shall be actuated by oil pressure controlled by external solenoid valves.
- VIII. The oil separator should be effective enough to incur gravity drop out of oil from the refrigerant gas before it enters the condenser.

B. Heat Exchangers (Condensers and Chillers)

- I. All condensers shall be of shell and tube type with water in the tubes and refrigerant in the shell.
- II. All chillers for chilled water plant shall also be shell and tube type with water either in tubes or outside the tubes.
- III. The heat exchanger shall be designed for a minimum working pressure of 10.5 kg/cm² gauge on the water side and 11.3 kg/cm² on the refrigerant side and shall generally conform to the latest ASME CODE for unfired pressure vessels Section- VIII. The design pressure shall have a reasonable margin over the maximum working pressure.
- IV. The average velocity of water in tubes shall not be more than 2.5 m/sec.
- V. Water heads or refrigerant heads of the heat exchangers shall be as not to allow leakage of fluid from one pass to the other.
- VI. Tube supports of adequate strength shall be provided to prevent the tubes from sagging and vibrating.
- VII. The overall fouling factor for the condensers and chillers shall be 0.0002 and 0.00013 Hr.M² °C /K Cal respectively.
- VIII. The condensers shall be designed to provide at least 2 °C sub cooling of refrigerant under rated design condition. The water chillers also shall be designed to superheat the refrigerant by at least 3 °C under rated design condition.
- IX. Testing and other design feature of the heat exchanger shall meet the requirements of TEMA Class-C heat exchangers or approved equal.

- X. The heat exchangers shall have open able water boxes for ease in maintenance.
- XI. The tube for water chillers shall be of deoxidised copper with or without integral fins. The tubes for the condensers shall also be copper with integral fins. The tube wall thickness at any point shall not be less than 18 SWG.
- XII. The baffle plates and the tube sheets shall be made of steel. The shell shall be made up of seamless tube or shall be fabricated from flange quality steel plate (ASTM-A285 Grade-C). The tube support plates shall be made of flange quality carbon steel plates and shall be as per TEMA Standard.
- XIII. The heat exchangers shall be provided with vent valve, relief valve, and/or safety fusible plug on refrigerant side and vent valve and drain valve on water side (at every section of the baffled shell of heat exchanger).
- XIV. The tenderer shall quote packaged units having compressor, condenser and chiller assembly together in a single framework and mounted on a common base plate. Provision for refrigerant charging and chemical cleaning of water tubes shall be provided.
- XV. Each heat exchanger shall be provided with water flow switch. This shall be interlocked with the control of the individual refrigeration system/corresponding compressor drive.
- XVI. All the heat exchangers shall be provided, with standard connections like thermo wells, inspection valve and antifreeze thermostat / temperature sensor and external equaliser connection for expansion valves for chiller. Insulation shall be terminated in such a manner that it will not be damaged during removal of bolts, covers etc. Separate covers similar to flange covers shall be constructed to facilitate easy removal.

6.04.00 Water Pumps

- 6.04.01 Each pump shall be of horizontal split casing / end suction centrifugal type, directly coupled to electric drive motor and mounted on a common base plate. Pumps having motor of 5 HP capacity or below can be of mono-block construction, provided its materials of construction are as mentioned below and motor is as per desired motor specification.

The pump shall be complete with casing, impeller, renewable type wearing rings, shaft, shaft sleeve, bearings, stuffing box, Mechanical Seal (if applicable), cowlings, base plate etc. as applicable. The design pressure for the casing shall not be less than 16 bar for chilled water pumps.

- 6.04.02 Pump head-capacity characteristics shall be gradually rising from operating to shut off point without any zone of instability. The pump BHP-flow characteristics shall be preferably be non-over loading type beyond rated capacity point.
- 6.04.03 Operating speed of the pump shall not preferably be more than 1500 rpm. Vibration isolations of efficiency 90% (approx.) shall be provided.
- 6.04.04 Material of the pump shall preferably as follows (all material shall be of tested quality).
- a) Casing : Cast Iron, as per IS 210, Gr FG 260 for both CHW & CW pumps. (As per manufacturer's Standard)
 - b) Impeller : Bronze to IS: 318 Grade 2
 - c) Shaft : Carbon Steel C-45.
 - d) Shaft sleeve : Bronze
 - e) Wearing ring : Bronze
 - f) Base Plate : Cast Iron
- 6.04.05 Pumps shall be provided with suitable bearings sized adequately to take the maximum possible unbalance load occurring due to all mechanical and hydraulic reasons.
- 6.04.06 Pump and drives shall be directly coupled through a flexible coupling. Suitable coupling guard shall be provided for each pump.
- 6.04.07 Each pump shall be completed with pressure gauge at the suction and discharge, isolating valves, all integral piping required for sealing and cooling, casing drain and vent connections etc. The pressure gauge of pump will be connected with a siphon and a two-position brass cock.
- 6.04.08 The rated BHP of the motor shall provide for 15% margin over the rated BHP of the pump. For other electrical particulars of the motor refer detailed specification of the motors.
- 6.04.09 The design of the pumps shall conform to the relevant IS Code.
- 6.04.10 Major rotating components of the pumps like impellers, balancing drums etc. shall be individually balanced statically and finally each pump shall be dynamically balanced.
- 6.04.11 The critical speed of the pump shall be at least 20% above the operating speed.

6.04.12 All pumps and motors shall be aligned properly, and bolted and doweled to a common base frame.

6.05.00 Induced Draft Cooling Towers

6.05.01 The cooling towers shall be cross flow induced draft type with FRP casing & sump with air entry on all four sides and air discharge on top. The fan motor shall be easily accessible from outside and out of moist air stream.

The internals shall be of stainless steel SS or MS epoxy painted to withstand corrosive atmosphere. The tower shall be of low height, suitable for round the clock operation at location in the space shown in the applicable drawings. The tenderer shall confirm that the tower supplied by them can be accommodated in the space shown in the drawing.

6.05.02 Cooling tower shall be of sufficient capacity to cool the rated amount of water through the specified range at the design W.B. temperature.

6.05.03 The structural frame work of the tower including all members and connections shall be designed for operating loads and prevailing wind pressure. Steel members shall be MS epoxy painted and be of sufficient size to safely withstand all imposed loads.

6.05.04 FRP casing sheets shall be clamped on close centre to the structural steel members. Rubber neoprene gaskets must be used on all bolted joints as a seal against water leakage.

6.05.05 Louvers shall be of fixed type.

6.05.06 The fan deck shall be of ample strength to support all loads normally encountered in operation and maintenance. Stiffeners shall be provided on the under side.

6.05.07 Galvanised steel ladder with safety cage and hand railing shall be provided in such a number and locations as necessary to give safe and complete access to all parts to tower requiring occasional inspection or adjustment. An access door shall be provided for fan deck and the cell for ready access to the interior parts of the tower.

6.05.08 Fills shall be of extended area of formed PVC suitable to withstand hot water temperature of 55 °C.

6.05.09 Louvers and drift eliminators shall be of PVC/FRP construction.

6.05.10 Eliminators shall be provided in removable sections & installed in the cell of the tower. The number of deflection in the eliminators shall be so arranged as to reduce drift loss to 0.2% of the water circulated.

- 6.05.11 The water distribution system shall be open basin with gravity feed nozzles. The system shall be self draining and non-clogging and designed for flexible operation and ready accessibility. All main piping connection shall be brought out and end in flanges, to flexible connection.
- 6.05.12 The cold water basin shall be of F.R.P. construction. The basin shall be complete with float valve for make up water control, a drain and overflow connection. The make-up water supply pipe shall be positioned at least double the pipe diameter above the maximum water level in the basin. The water basin shall be constructed such as to provide a coarse strainer of Brass wire mesh easily accessible from outside.
- 6.05.13 Fan shall be of the propeller type, cast aluminium and multi bladed aerofoil construction with adjustable pitch. The entire fan assembly shall be statically balanced. Outlet velocity of air shall be not less than 610 meters per minutes and the fan tip speed shall not exceed 4570 meters per minute.
- 6.05.14 Each fan shall be gear driven. Where reduction gears are used, housing shall be of heavy cast iron construction with large oil reservoir and complete with supply of oil.
- 6.05.15 Fan motors shall be of the totally enclosed fan cooled type and of the required capacities. Motor shall preferably be located outside the moist air stream.
- 6.05.16 Fan drive shaft using reduction gearing shall be dynamically balanced and connected through flexible couplings.
- 6.05.17 The mechanical equipment assembly shall be adequately supported on the fan deck.
- 6.05.18 Fan discharge hatch shall be covered with galvanised wire mesh to prevent birds nesting during idle periods.
- 6.05.19 All nuts, bolts and fasteners used in the cooling tower shall be stainless steel / Nickel or chrome plated.
- 6.06.00 **Piping**
- A. Refrigerant Piping
- I. Refrigerant piping shall be of M.S. seamless (as per IS-1239, Part-I heavy grade) or copper tube (IS-5493). Welding rings shall be used for smaller pipes. Weld preparation of joints, cleaning of pipes shall be carried out as per relevant code.
- II. Pressure drop in hot gas, liquid and suction lines should not exceed the value corresponding to 2 °F (1.1 Deg C) change in saturation temperature of the fluid.

- III. Velocity in the discharge and suction pipe of the refrigerant shall not be too high as to create undue vibration and noise, velocity in the vertical length of discharge and suction pipe of the refrigerant shall be high enough to carry the entrained oil in the refrigerant, even in case of unit running at lowest partial capacity. An angle type drain valve with male flare outlet connection will be installed at the bottom end of each vertical riser pipe to drain any accumulated oil.
 - IV. Instrument piping for gauges, switches etc. shall be copper only. Capillary tubes will be used wherever possible. For field-mounted instruments, this is not applicable.
 - V. Spacing and location of hanger shall conform to preferred engineering practice. Hangers and supports shall be made up of structural steel sections. The design of the hangers and supports shall provide for suitable protection to insulation on the pipes, wherever applicable. All materials for anchoring the hangers with reinforced concrete work or building structural beams and columns shall be furnished by the Bidder.
 - VI. Liquid-moisture indicator with leak proof glass on opposite sides shall be provided in the liquid line for facilitating visual inspection of liquid refrigerant charge.
 - VII. The liquid line shall be provided with Drier-Strainer.
- B. Water Piping
- I. Condenser cooling water piping and chilled water piping for 150 NB or below GI-Heavy Class conforming to IS-1239, Part-I, for higher sizes black steel pipe, heavy grade conforming to IS-3589, Fe 410 grade. Drain water piping shall be of M.S. heavy grade.
 - II. The piping shall be so designed that the water velocity through the piping shall not exceed 2.5 m/sec and also the piping friction drop shall be limited to 4 m per hundred meters of pipe length. Pipe sizes indicated in tender drawings shall be followed.
 - III. The pipes shall be of plain end in case of M.S. Pipes (i.e., suitable for welded connections) as far as possible.
 - IV. Counter-flanges for connecting to flanges on valves or equipment shall be made of IS-2062 or superior and shall preferably be slip on type, suitable for welding on the piping in case of M.S. Piping.
 - V. All bolts and nuts for flange connection shall be hexagonal carbon steel type as per IS-1363 and with the material and other requirements as per IS-1367. All threaded valves shall be provided with nipples and flanged pairs on both sides to permit flanged connections for ease of removal / replacement of valves.
 - VI. Bends, fittings fabricated at site are not acceptable. The Contractor shall use the standard fittings / bends, as per IS-1239, Part-II.

- VII. Spacing and location of hanger shall conform to preferred engineering practice. Hangers and supports shall be made up of structural steel sections. The design of the hangers and supports shall provide for suitable protection to insulation on the pipes, wherever applicable. All materials for anchoring the hangers with reinforced concrete work or building structural beams and columns shall be furnished by the

Bidder. The supports within the plant room shall be of structural/pipe supports from the floor, provided by the A.C. Contractor.

- VIII. The flanged joints for water line will use canvas, impregnated rubber gasket. Compressed fiber gaskets shall be used with flat face flanges and raised face slip-on flanges. Spiral wound gaskets shall be used with raised face flanges, except for raised face slip-on flanges. Gaskets containing asbestos are not acceptable.

Gaskets shall be suitable for the design pressures and temperatures: -

- i) **Compressed Fiber Gaskets:** Compressed fiber gaskets shall be in accordance with ANSI B16.21, and materials shall be suitable for a maximum working pressure of 40 bar and a maximum working temperature of 400° C. Gaskets shall be dimensioned to suit the contact facing. They shall be full faced for flat face flanges and shall extend to the inside edge of the boltholes on raised face flanges. Gaskets for plain finished surfaces shall be not less than 1.6 mm thick and for serrated surfaces shall be not less than 2.4 mm thick.
- ii) **Spiral Wound Gaskets:** Spiral wound gaskets shall be constructed of a continuous stainless steel ribbon wound into a spiral with non-asbestos filler between adjacent coils. The gasket shall be inserted into a steel gauge ring whose outside diameter shall fit inside the flange bolts properly positioning the gasket. The gauge ring shall serve to limit the compression of the gasket to the proper value. Compressed gasket thickness shall be 3.3 mm $\pm$ 0.1 mm.
- iii) **Ring Joint Gaskets:** Ring joint gaskets shall be octagonal in cross section and shall have dimensions conforming to ANSI B16.20. Material shall be suitable for the service conditions encountered and shall be softer than the flange material.
- iv) **Rubber Gaskets:** Rubber gasket materials shall be cloth inserted sheet rubber and shall conform to ANSI B16.21. They shall be full face and 1.6mm thick.

The material should be able to withstand adequate strength in compression without damage. Pipe lines should be such installed that any equipment or valves can be removed by disconnecting flange bolts and nuts union joints. If necessary, a short piece joint to be installed for easy removal. All threads for screwed joints should be properly made. The threads will be covered to make a leak proof joint. Pipes passing through any building structure will pass through a pipe sleeve. The thickness of pipe sleeve will be not less than the

thickness of the passing pipe itself. A rubber grommet or such other material will protect pipes entering any equipment.

- IX. All drainpipes will use 'tee' fitting instead of elbows or bends. 'Tee' fitting should be such installed that the plug can be removed and any section of pipe can be cleaned. Drain valves will be located at lowest point of pipelines. If necessary more than one drain valve will be

installed to facilitate complete drainage from pipe. Condensate drain piping shall be insulated as per the specification.

- X. Water filling valve and air vent shall be installed on the highest point of pipeline. If necessary more than one valve is to be installed for satisfactory operation or maintenance of the plant. In case of insulated pipes the connections for pressure gauge, thermometer, drain valve, purge valve, filling valve and any such other accessories, the connection should be long enough such that the requisite pipe insulation can be carried out on the main pipe. The connecting pipes or fittings will be insulated separately if necessary. Location of instruments, fittings, fixtures shall be as in single line flow diagram. Location / sizes of air vents are also indicated.

- XI. The insulation will be fixed as per manufacturer's recommendation. Where valves, pipe fittings etc. occur, access to both shall be provided. Flange insulation shall be in two halves for easy removal without affecting insulation covering adjacent parts. Insulation of valves shall be with provision of aluminium valve boxes with hinged cover / halves.

- XII. Piping arrangement and alignment shall be as per layout.

6.07.00 Valves & Accessories

A. General

Valve pressure classes, sizes, types, body materials, and end preparations shall generally be as described herein. Special features and special application valves shall be utilized where required.

Valves specified to have flanged, socket-welded, or screwed connections shall have ends prepared in accordance with the applicable ANSI standards. Steel flanges shall be raised face type unless otherwise required. Cast iron and bronze flanges shall be flat-faced type. Butt-welding ends shall be prepared in accordance with 2.11.5 Butt Weld End Preparation and Piping Fit-Up.

Steel body gate, globe, angle, and check valves shall be designed and constructed in accordance with ANSI B16.34 as applicable. Valve bodies and bonnets shall be designed to support the valve operators (hand wheel, gear, or motor) with the valve in any position, without external support.

B. Steel Body Valves 50 mm and Smaller


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Steel body valves 50 mm and smaller shall have forged steel bodies. Forged steel valves complying with the standards and specifications listed in Table 126.1 of ANSI B31.1 shall be used within the manufacturer's specified pressure temperature ratings with the following limitations. The use of Class 1500, 2500, and 4500 forged steel valves shall be limited in accordance with the pressure temperature ratings specified in ANSI B16.34, and the criteria established in MSS SP-84.

Class 800, 1500, 2500 and 4500 forged steel valves shall be constructed as follows: -

- a) Class 800 valves shall have bolted bonnet joints. Class 1500, 2500 and 4500 valves shall have pressure seal, integral, or breech lock bonnet joints. Gate, globe, and angle valves shall have outside screw and yoke construction.
- b) All valves, except gate valves, shall have seats of the integral type. Gate valves shall have renewable seats.
- c) Class 1500, 2500, and 4500 valves shall be of loose back seat design.
- d) Class 1500, 2500, and 4500 globe valves shall be of the Y-pattern type.
- e) Valve ends shall be socket-weld type unless otherwise required.
- f) Except as otherwise required, check valves shall be of the guided piston or swing disk type. All check valves shall be designed for installation in either horizontal piping or vertical piping with upward flow.

C. Steel Body Valves 65 mm and Larger

Steel body valves 65 mm and larger shall have cast steel bodies. The face-to-face and end-to-end dimensions shall conform to ANSI B16.10. The use of these valves shall be in accordance with the pressure temperature ratings specified in ANSI B16.34 as applicable.

Gate, globe, and angle valves shall be provided with back seating construction; and shall be of outside screw and yoke construction. Gate valves 100 mm and larger shall have flexible wedge disks. Split disks shall not be permitted. Valves shall have full size ports, except where venturi ports are specifically permitted to Engineer's approval. The use of valves with venturi ports shall be limited to selected large diameter, high-pressure valve applications.

Class 150, 300, and 400 valves 65 mm and larger shall be constructed as follows: -

- i) Bonnet joints shall be of the bolted flanged type having flat face flange facings for Class 150 valves; and male and female facings for Class 300 and 400 valves.
- ii) Body ends shall be butt weld type unless otherwise required.

Class 800, 900, 1500, 2500, and 4500 valves 65 mm and larger shall be constructed as follows: -

- i) Bonnet joints shall be of the pressure seal or breech-lock type.
- ii) All Class 800, 900, 1500, 2500, and 4500 valves shall have grease-lubricated antifriction bearing yoke sleeves.
- iii) Body ends shall be butt weld type unless otherwise required.

Check valves used on pump discharge installations, and on other applications in which the valves may be subjected to significant reverse flow water hammer or fluid surges, shall be of the non slam tilting disk type. All other check valves shall be of the guided piston, swing disk, or double disk spring check type. The use of double disk spring check valves shall be limited to 350 mm and larger cold-water services. All check valves shall be designed for installation in either horizontal or vertical piping with upward flow. Stop check valves, where specified, shall be Y-pattern globe type.

D. Iron Body Valves

Iron body gate, globe, and check valves shall have iron bodies with bronze trim. The face-to-face dimensions shall be in accordance with ANSI B16.10. These valves shall have flanged bonnet joints. Gate and globe valves shall be of the outside screw and yoke construction. Body seats shall be of the renewable type. Gate valves shall be of the wedge disk type. Lined cast iron body diaphragm and check valves used with lined piping shall be flanged body with liner and diaphragm material suitable for the service.

E. Butterfly Valves

Rubber-seated butterfly valves shall be generally constructed in accordance with AWWA C504 Standard for Rubber-Seated Butterfly Valves. The valves shall also generally conform to the requirements of MSS Standard Practice SP-67, Butterfly Valves. Valves of the wafer or lug wafer type shall be designed for installation between two ANSI flanges. Valves with flanged ends shall be faced and drilled in accordance with ANSI B16.1. The selected use of butterfly valves shall be in accordance with the pressure temperature ratings specified in AWWA C504, the pressure temperature ratings specified by the manufacturer as per the following criteria: -

- a) Butterfly valves shall generally be used for 150 mm and larger cold-water services only.
- b) Butterfly valves for buried service shall be of cast iron body material and shall be equipped with flanged ends.
- c) Cast iron butterfly valves shall have pressure class selected based on the piping design pressure as follows:

	Piping Design Pressure	Valve Class
i)	1.8 bar and below	Class 25

ii)	Above 1.8 bar to 5.2 bar	Class 75
iii)	Above 5.2 bar to 10.3 bar	Class 150
- d) Cast iron butterfly valves shall be limited to use with piping systems having a design temperature of 50 C or less.
- e) Butterfly valves for other than buried service shall be of carbon steel or cast iron body material depending on the service application. Valves 600 mm and larger in size shall be equipped with flanged ends. Valves 500 mm and smaller in size shall be of the wafer type, or lug wafer type, if used with steel piping; and shall be flanged if used with other piping materials (cast iron, etc.).
- f) Carbon steel butterfly valves shall be limited to use with piping systems having a design temperature of 65 C or less. Carbon steel butterfly valves shall have pressure class selected in accordance with the pressure temperature ratings specified in ANSI B16.34 for 600 mm and smaller valves. Valves 750 mm and larger in size shall be selected and specified based on the piping design pressure and temperature, without reference to a specific pressure class.

Metal seated or Teflon seal ring seated butterfly valves for special service applications shall be of the wafer or lug wafer type; and shall be designed for installation between ANSI flanges. The use of these valves shall be in accordance with the pressure temperature ratings specified by the manufacturer.

F. Bronze Body Valves

Bronze gate and globe valves 50 mm and smaller shall have union bonnet joints and screwed ends. Bronze gate and globe valves used in control air service shall have brazed joint ends. Gate valves shall be inside screw, rising stem type with solid wedge disks. Globe valves shall have renewable seats and disks.

Bronze check valves 50 mm and smaller shall be Y-pattern swing disk type or guided piston type designed for satisfactory operation in both horizontal piping and vertical piping with upward flow.

Bronze valves 65 mm and larger shall have bolted flange bonnet joints and flanged ends. Gate and globe valves shall be of the outside screw rising stem construction. Gate valves shall have either integral or renewable seats. Globe valves shall have renewable seats.

The use of these valves shall be in accordance with the pressure temperature ratings specified by the manufacturer and in accordance with the criteria established in MSS SP-80. Bronze valves shall generally be Class 200, and shall be limited to service with piping systems having design pressures of 14 bar or less, and design temperatures of 65°C or less.

Bronze valves shall generally be limited to a size of 80 mm or less.

G. Plug Valves

Plug valves shall be of the eccentric, lubricated, or Teflon sleeve plug type, as required by the service. Plug valve bodies shall conform to the requirements of ANSI for dimensions, material thickness, and material specifications. Bonnets shall be of the bolted flange type. Body ends shall be flanged, faced, and drilled

for installation between ANSI flanges. The use of these valves shall be in accordance with the pressure temperature ratings specified by the manufacturer.

H. Ball Valves

All ball valves shall have full area ports, Teflon seats & seals, and chrome plated carbon steel or stainless steel balls. Ball valve bodies 50 mm and smaller shall have threaded end connections. Ball valves 65 mm and larger shall have flanged ends. The valves shall not require lubrication. The use of these valves shall be in accordance with the pressure temperature ratings specified by the manufacturer.

I. Check Valves

These shall be swing check type with material of construction as given above. The body shall be of cast iron with flanged ends.

J. Flow Regulating-Cum-Measuring Valves

These are special valves to be installed at the outlet of each cooling coil/heating coil as shown in drawings. The Contractor shall also supply measurement it including manometer. The valves shall be of variable orifice design double regulating type. The valve shall have measurement ports for connecting the manometers. The Contractor shall supply all calibration charts etc. The valve shall have provision for locking at pre set flow condition and it shall be possible to close the valve and again open up to this pre set point. The valves shall be of gun-metal/bronze construction.

K. 3-Way Mixing Valves

These are special valves to be installed at the outlet of each AHU heating coil as shown in drawings. The motor shall be actuator based controlled. The valve shall operate from the sense of the room thermostat. The Contractor shall also supply measurement kit including manometer. The valves shall be of variable orifice design double regulating type. The valve shall have measurement ports for connecting the manometers. The Contractor shall supply all calibration charts etc. The valve shall have provision for locking at pre-set flow condition and it shall be possible to close the valve and again open up to this pre set point. The valves shall be of gunmetal / bronze construction.

L. Refrigerant Valves

All refrigerant valves as may be applicable shall have Brass body with flange connection or sweat connection for welding or brazing to pipe. For copper pipes size 5/8" and below flare connection will be acceptable. The valve body and bonnet connection shall have bolted and welded connection.

It is preferable to have Teflon gland packing for the valves construction of the discs of the valves shall be either globe or angle type. The valve seat shall have white metal lining or any equivalent soft replaceable lining. The valves shall be of tested quality. Leak proof-ness of the valves shall be tested at

minimum 1.5 times the design pressure for the system but not less than 35 Kg / Sq. Cm.

6.08.00 Air Handling Equipment

6.08.01 Air Handling Units

A. FAN

The fans shall be forward/backward curve bladed centrifugal type. The number of fans per unit shall be as per standard of the manufacturer. The impeller and the scroll casing of the fans shall be made of steel and protected with suitable painting as per Manufacturer's standard.

The fan shaft shall be of Carbon steel. Bearing shall be heavy-duty self-aligning type. The fans shall be dynamically balanced. The motor shall be adequately rated to prevent overload.

B. DRIVE

Centrifugal fans shall be equipped with V-belt drive and belt tensioning arrangement. All belts shall be sized with 1.1 service factor. All belt drive shall be equipped with removable guards to avoid accidental hazards. There shall be a minimum of two belts per drive.

C. DRY FILTER

The filter media shall be designed to hold dust and prevent it from being dislodged by vibration or other cause and passing through filter.

The filters shall be of dry panel type. The filter shall have G.I. frames of adequate thickness but not less than 20 SWG suitable for long use in an industrial plant. The filters may be in panels of sizes about 600 mm x 600 mm for easy handling of the same. The face velocity of air across the filters shall not exceed 2.5m/sec and maximum limitation pressure drop will be 6 mm of WG. Filter thickness will be at least 50 mm. The efficiency shall be about 90% down to 10-micron size particles.

D. COOLING COIL

The cooling coil for chilled water shall consist of seamless copper tubes with aluminium fins. There shall be preferably only one cooling coil per AHU or as per manufacturer's standard.

The cooling coil for chilled water plant shall be equipped with manually - operated flow regulating valve with provision for flow balancing at site to control the chilled water flow. This cooling coil shall be designed for chilled water / air duty. Counter-flow process of heat transfer shall be considered in the design requirement. The flow factor of 0.001 Hr. Sq. Ft. - °F / BTU (0.0002 hr - Sq. M °C / Kcal) shall be taken in the design of the cooling coil. Number of rows shall be minimum 4 and shall follow even number for any

particular coils to facilitate connection of water/refrigerant only on one side of the unit.

Fin design shall be chosen for the duty to be performed with special attention to the possibility of lint accumulation. However, in any case, number of fins in the coils shall not exceed 13 / Inch. Velocity of air across the coils shall be limited to 2.5 m/sec.

In case of chilled water-cooling coil, arrangement for air purging and water draining from the coil is to be provided.

E. CASING

- a) The casing shall be of double skin type GI with at least 25mm thick PUF insulation (density approximately 35Kg/ M³) in between two skins (made of 24 G GI sheet) and complete with supply air outlets with volume control dampers and flexible connections, structural frame work with supports and serrated rubber pads as vibration isolators and shall be provided with thermal break at the joints of different sections. Outer skin of the AHU shall be powder coated.
- b) Base frames shall be supplied for floor mounted type units. Drain pans shall be in SS-304 construction having at least 65mm depth and shall be fabricated in such a way to form the slope towards drain point.
- c) The main structure of the Unit (i.e. framework) shall be in extruded aluminium construction. The structural members shall have industrial anodized finish to form scratch proof, corrosion resistant, smooth finish surface. The structural member shall have a thermal break between inner & outer surface to minimize heat loss. The sealing surface of the extrusions shall be provided with the groove to hold the gasket. The gasket shall be of synthetic construction having tubular shape for proper sealing. The inner face of the panels shall be flushed with inner face of the extrusions to minimize the corners.
- d) Panels of the casing shall be fitted reasonably airtight with suitable gaskets with cams or similar fastenings for easy opening.
- e) Necessary arrangement shall be provided on the casing for measuring temperature and pressure in a cooling coil.


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- f) Easily open able inspection doors shall be provided at required locations for easy maintenance. The Doors shall have handles and hinges in glass filled nylon construction.
- g) The Lock shall be flushed type to minimize projections. Locks shall have proper arrangement to secure the doors tightly.

6.08.02 Fan Coil Units

- A. The fan coil units shall be of reputed make – horizontal type for ceiling suspension. The units shall be complete with chilled water coil, one or more centrifugal fans and motors, cleanable HDPE filters, double wall insulated condensate drain pan with 15 mm thick expanded polystyrene (self extinguishing quality) insulation sandwiched between top and bottom sheets of drain pan and 18 gauge sheet steel casing panels. Horizontal fan coil units shall be provided with auxiliary secondary condensate drain pans.
- B. Access panels shall have positive locking fasteners for easy removals. The filters shall be mounted at the rear section of the cabinet with filter box.
- C. All cooling coils shall be standard three row staggered seamless copper tube with aluminium plate fins mechanically bonded to copper tubes. Tubes shall be aluminium 10 mm O.D. and wall thickness shall be minimum 0.5 mm. All bends and joints shall be enclosed within the insulated end sections of the base unit for protection against sweating. Each coil shall be provided with an air vent and drain plug. All coils shall be factory tested at 21 kg. Per Sq. cm. air pressure while submerged in water. Fin spacing shall not be less than 10 fins per inch. Tubes shall be mechanical / hydraulically expanded for thermal contact resistance with fans.
- D. Fans shall be centrifugal, forward-covered, and direct driven by shaded pole motor.
- E. All fans coil units shall be equipped with copper piping connection and manual air vent at the cooling coil. Other accessories shall be wall mounted thermostat for individual unit, containing two speed and ON / Off control for fan speed, motorized three-way diverting/mixing valve for individual unit, Y-strainer, ball valve and globe valve, adjustable discharge air grilles.
- F. The fan coil unit shall be selected for the lowest operating noise level. It should offer capacity at the lower speed.

6.09.00 Air Filters

6.09.01 Pre-Filters

The filter media shall be designed to hold dust and prevent it from being dislodged by vibration or other cause and passing through filter.

The filters shall be of HDPE construction. The filter shall have G.I. frames of adequate thickness but not less than 20 SWG suitable for long use in an industrial plant. The filters may be in panels of sizes about 600 mm x 600 mm for easy handling of the same. The face velocity of air across the filters shall not exceed 2.5m/sec and maximum limitation pressure drop will be 6 mm of WG. Filter thickness will be at least 50 mm. The efficiency shall be about 90% down to 10-micron size particles.

6.09.02 High Efficiency Filters

The filters shall be having efficiency of 99% down to 5 microns. The filters shall be of cleanable type construction of reinforced glass fiber or cotton fabric or fabric-like material sandwiched in between two galvanized wire netting arrangement in a uniformly corrugated form to increase the surface area.

The filters shall have G.I. frames of adequate thickness suitable for long use in an industrial plant. The filters may be in panels of size about 600 x 600 for easy handling.

The filter panels shall be mounted on the ladder type angle iron holding frames. The frames shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters. Face velocity of air across the filters shall not exceed 1.5 m/sec.

High efficiency filters shall be provided with differential pressure switch with alarm.

6.10.00 Duct Work

6.10.01 Velocity of air in any section of the supply duct shall not exceed 8 m/sec.

6.10.02 Sheet metal thickness for AC duct shall conform to IS-655.

6.10.03 The general layout of the ducting location and number of air grilles and diffusers etc. shall conform to the specific requirements of individual areas of application so as to ensure proper air distribution of all the zones. The same shall be subject to approval by the Engineer.

6.10.04 Where dimensional locations are not indicated on the drawings, the Contractor will be responsible for the final arrangement and routing of the ductwork. Variations in duct sizes may be made as acceptable to the Owner if the cross-sectional area remains the same and the revised aspect ratio is less than four. Ductwork will be arranged to minimize pressure drop using low-loss fittings and transitions. Where radius elbows are used for duct turns, the radius ratio will not be less than 1.5 wherever possible. Where space limitations require a bend with a radius ratio of 0.75 or less, not less than two turning vanes will be installed in the bend.

6.10.05 All ductwork for supply of air inclusive of accessories such as damper, vanes, access doors etc. shall be fabricated from G.I. sheet of at least grade 180 as per IS 277 or aluminium sheet. The ductwork shall be properly reinforced to prevent sagging, buckling or vibration. Interior of all ducts shall be smooth and free from obstruction. All duct sections shall be cross-broken.

6.10.06 The construction of ducts shall conform to IS : 655/ASHRAE/SMACNA as far as applicable, unless otherwise stated here.

6.10.07 JOINTS

- a) All longitudinal joints for the ducts will be Pittsburgh Lock seam type.
- b) Transverse joints for the low-pressure ducting shall be continuous around the four sides, the corner closure are required. The type of transverse joints shall be as follows:

<u>Large side mm</u>	<u>Type of transverse joints</u>
Up to 600	25 mm wide pocket, drive or S-slip
601 - 1000	85 mm wide, bar s-slip or pocket slip
1001 – 2250	40 mm x 40 mm x 6 mm M.S. angle connection

- c) The low-pressure ducting work shall be provided with intermediate transverse bracing continuous around the four sides between the joints according to the following sizes:

<u>Large side mm</u>	<u>Bracing</u>
0 - 450	None
451 - 1500	40 mm x 40 mm x 6 mm angle 1200 from joints.
1501 and above	40 mm x 40 mm 6 mm angle 600 mm from joints.

- d) Riveting and Sealing

All joints, slips and seams shall be made secure by reverting on centres not exceeding 150 mm. All transverse stiffeners and all reinforced bar slip joints shall cross at corners and be riveted. All bar slip joints and angle iron bracing shall be riveted on centres not exceeding 75 mm.

- e) All construction joints and duct seams shall be reasonably sealed with bitumastic cold emulsion or equivalent vapour seal.

6.10.08 Hangers and Supports

- a) All ductwork shall be provided with adequate hangers or supports to ensure rigid support and to prevent vibration. Spacing of duct supports shall not exceed 3 m centres.
- b) Hangers shall be suspended from the building steel with provision for necessary auxiliaries, or special steel members, or by hooks fixed to the embedded plates provided in the ceiling.
- c) Hangers for all ducts shall be trapeze type with the shelf construction from 35 mm x 35 mm x 5 mm angle iron and hung by two steel rods each of not less than 10 mm dia. for ducts, with larger side less than 2250 mm while for those greater than 2250 mm shall be with 50 x 50 x 5 angles and rods not less than 16 mm dia.
- d) All hangers and supports shall be as per drawings / specifications. When vertical ducts pass through floor slab, they shall be supported by means of collars, constructed of steel structural angles securely fastened about the girth of the duct and bitumastic compound between the horizontal leg of the supporting angle and the floor. The duct aspect ratio shall not be more than 4: 1. Turning vanes are required to be provided with bend more than 45 Deg.

6.10.09 Access Doors

All main ductwork shall be accessible throughout using tight fitted hinged access doors. Doors shall have to be cemented on sponge rubber gaskets. Angle joints shall be provided with felt or rubber gaskets for leak-tightness of the joints.

Access doors/panels are to be provided at following places:

- Near each fire damper
- Near each heater coil
- Near each filter bank

In case access doors are to be installed in the insulated ducts, the access door panel should be suitably insulated, such that it can be operated without damaging the duct insulation and there should be no condensation either on the access doors or on the duct when the plant is running.

6.10.10 Flexible Connection

Rubber impregnated canvas or equal flexible connections of at least 150 mm length shall be provided at each connection between ductwork and fan units.

6.10.11 Dampers

- i) **SPLITTER DAMPER**

Splitter dampers in branch take off shall be provided. Dampers blades shall be minimum 16 SWG thick. Alternatively catcher shall be provided in right angle tee of ducts.

ii) FIRE DAMPER

Fire dampers shall be provided as per the requirement mentioned elsewhere in the specification. The fire dampers shall be of motorised / solenoid/fusible link type operated by smoke detectors of the zone fire fighting system. The fire damper shall be smoke-tight type and shall have 120 min. fire rating. Provision shall be kept for manual operation of the damper.

Blade thickness : At least 16G CRCA
Frame : At least 40 x 40 x 3 mm Angle.

Motorised Fire Dampers shall be rated for 240 V, 50 Hz, 1 Ph., AC supply. Motor for Fire dampers shall be continuously rated. These Dampers shall close on de-energisation and open on energisation of Motor. Provision shall be kept for manual operation of the Damper.

Fire dampers will be provided at the supply/exhaust duct for fire-rated walls/floors as required by National Fire Protection Association (NFPA) and International Building Code (IBC).

iii) ACTUATORS

The actuators will be UL listed.

Dampers will be equipped with operators of sufficient power to control dampers, without flutter or hunting, through the entire operating range at air velocities at least 20 percent greater than maximum design velocity. Operators will have sufficient power on closure to provide tight sealing against maximum system pressures. Damper actuators will be designed to provide a minimum of 200 percent of the torque required to operate the damper and to meet the air leakage criteria. Damper actuators will not be less than 2.26 N-m (20 inch-pounds). Each damper section will contain one or more damper actuators. Jack-shafting of the section is not permitted.

Operators functioning in sequence with other operators will have adjustable operating ranges and set points.

Spring-return operators will be provided for two-position control or on reversible operators where required for fail-safe operation.

Electric motor operators for modulating control will be reversible type.

Locations where temperatures fall below minimum operating temperature of operator will be heated.

When dampers are installed on ducts to be externally thermally insulated, each damper operator will be equipped with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of insulation. Standoff mounting items will be integral with the operator or standard accessory of damper manufacturer.

iv) OPPOSED MULTIPLE LOUVRE DAMPER

Opposed multiple louvers dampers shall be provided at the fan outlets and wherever mentioned in the drawings, specification and fan schedule. Each blade of the dampers shall be provided with bronze, gunmetal or nylon bearing at each end of its spindle. The spindle with bearing shall be mounted in a strong structural framework. Operating lever with fixing device for keeping the damper at the desired position shall be fitted for the manually operated dampers.

Operating level will be fixed on an indicator to show the percentage of opening of the damper in all cases except for the application with grilles and nozzles.

Velocity across the dampers shall not exceed 10 m/sec. Damper blades at fan outlet shall be made up of 16 gauge M.S.

6.10.12 Diffusers, Grilles, Registers - Conventional Design

Design of grilles & diffusers shall be such as to create desired throw and spread of air and shall be approved by the purchaser/engineer.

All diffusers and grilles shall be made up of powder coated sheet steel / extruded aluminium with finish painting. Design of all diffusers and grilles shall be made by the Contractor matching with the lighting and other fittings and to be approved by the Engineer. Each supply air diffusers shall be fitted with opposed blade damper, built-in vanes and louvers arranged as per manufacturer's standard design.

Side throw type supply registers shall have two sets of adjustable louvers with opposed blade dampers. The front of louvers shall be horizontal to provide horizontal deflection and the rear set of vertical louvers shall adjust vertical deflection. The dampers shall have horizontal opposed blades regulated by an operating lever in the frame. All wall type exhaust / return air grilles shall have one set of louvers in the front. The louvers shall be fitted such as to remain in position by friction grip. All supply air grilles shall have one set of opposed multiple louver dampers at the inlet. The dampers shall be gang operated and will have a device to keep the dampers fixed in one position.

The grille frame and louvers shall be manufactured of at least 20 SWG GI sheet and 22 SWG M.S. respectively. No grilles should by any chance make any rattling sound during continuous operation. All grilles shall match the decor of the space.

All grilles/diffusers shall be fitted with suitable gasket to prevent air leakage.

6.11.00 **Insulation**

6.11.01 Thermal Insulation

- A. The following items are to be insulated:
- I. Refrigerant suction piping from the evaporator coil outlet up to the compressor inlet shall be insulated with minimum 39 mm thick aluminium foil faced Nitrile rubber/ XLPE for Screw type Package Water Chilling Unit and 26 mm Nitrile Rubber/XLPE with 30G Aluminium sheet Cladding for Precision/ Split Air Conditioner. For better efficiency of operation the liquid line running side by side with the suction line may be insulated together with the suction line already mentioned.
 - II. Double skin Casing of the cabinet type air-handling unit with at least 25 mm thick Poly Urethane Foam (PUF)/ EPS sandwiched between them.
 - III. Supply air duct and part of the return air duct passing through non conditioned space, if any, with at least 13mm thick aluminium foil faced Nitrile Rubber / XLPE Insulation.
 - IV. Entire chilled water-piping, valves, chilled water circulating pumps, and chillers with 39 mm thick aluminium foil faced Nitrile rubber/XLPE.

The portion of Chilled water piping exposed to atmosphere shall be insulated with 50 mm thick (TF quality) expanded polystyrene and finished with chicken wire mesh, 12 mm thick sand-cement plaster and an overall cladding of 30G Al. sheet.
 - V. Drain Piping from AHU/Precision ACs /Split AC unit/ FCU and Chillers shall be insulated with 13 mm/ 6mm (for FCU and Split units) thick aluminium foil faced Nitrile Rubber/ XLPE.
 - VI. Screw type Packaged Chiller and Chilled Water Pump shall be insulated with 39 mm thick aluminium foil faced Nitrile Rubber/ XLPE.
 - VII. Chilled water Expansion tank drain piping with 6 mm thick aluminium foil faced Nitrile Rubber/XLPE.
 - VIII. Insulation of Precision AC Unit/ Split AC Unit shall be as per manufacture's standard.
 - IX. Roof of AC spaces shall be insulated with 25 mm thick EPS (under deck) for not exposed to sun and 50mm thick EPS (under deck) for exposed to sun.
- B. Insulation shall be fixed as per manufacturer's recommendation. Due care shall be taken to avoid damage to vapour arresters and insulation.
- C. Extra insulation thickness shall be provided at duct pipe hangers and special care shall be taken to seal the insulation and hanger member penetrations and instruments and accessories tapings.

- D. Special care shall be taken to provide satisfactory insulation for valves, flanges, vessel connections etc. with proper facility for maintenance and inspection.
- E. Insulated ducts crossing the floors shall have to be normally protected from damage and water splashing by providing suitable cladding up to 300 mm from the floor level.

6.11.02 Acoustic Insulation

All supply air ducts in the air conditioning system shall be insulated with Acoustic insulation of 25 mm thick open cell erosion resistant Nitrile Rubber foam of density min. 140 Kg/CuM provided in the ducting up to a length of 6 M from the Air Handling Unit / Precision Air Conditioner.

6.12.00 Precision / Split AC Units

6.12.01 Water Cooled Precision Air Conditioners

A. Compressor

The compressor shall be hermetically sealed scroll type medium speed, single acting type designed for R-407C/410A duty. The compressor shall be complete with crank case heater (to be energised when compressor is on off cycle).

The compressor shall have proper lubrication system. Safety devices viz. high-pressure switch, low-pressure switch, low oil pressure (if applicable) shall be provided and such devices shall be electronically operated. Manual reset on safety cut out shall be provided. The horsepower for the compressor motor shall be adequately sized or 110% of the rated power required for the unit including drive loss.

Capacity control shall be devised by providing at least two compressors.

B. Condenser

All condensers shall be of shell and tube type with water in the tubes and refrigerant in the shell.

The heat exchanger shall be designed for a minimum working pressure of 10.5 kg/cm² gauge on the water side and 19.0 / 27.0 kg/cm² for R-407C / 410A on the refrigerant side and shall generally conform to the latest ASME CODE for unfired pressure vessels Section- VIII. The design pressure shall have a reasonable margin over the maximum working pressure.

The average velocity of water in tubes shall not be more than 2.5 m/sec.

Water heads or refrigerant heads of the heat exchangers shall be as not to allow leakage of fluid from one pass to the other.

Tube supports of adequate strength shall be provided to prevent the tubes from sagging and vibrating.

The overall fouling factor for the condensers shall be 0.0002 Hr.M²°C/K.Cal.

The condensers shall be designed to provide at least 2 °C sub cooling of refrigerant under rated design condition.

Testing and other design feature of the heat exchanger shall meet the requirements of TEMA Class-C heat exchangers or approved equal.

The heat exchangers shall have open able water boxes for ease in maintenance.

The tubes for the condensers shall also be copper with integral fins. The tube wall thickness at any point shall not be less than 18 SWG.

The baffle plates and the tube sheets shall be made of steel. The shell shall be made up of seamless tube or shall be fabricated from flange quality steel plate (ASTM-A285 Grade-C). The tube support plates shall be made of flange quality carbon steel plates and shall be as per TEMA Standard.

The heat exchangers shall be provided with vent valve, relief valve, and/or safety fusible plug on refrigerant side and vent valve and drain valve on water side (at every section of the baffled shell of heat exchanger).

The tenderer shall quote packaged units having compressor, condenser and evaporator assembly together in a single framework and mounted on a common base plate. Provision for refrigerant charging and chemical cleaning of water tubes shall be provided.

Each heat exchanger shall be provided with water flow switch. This shall be interlocked with the control of the individual refrigeration system/ corresponding compressor drive.

All the heat exchangers shall be provided, with standard connections like thermo wells, inspection valve and antifreeze thermostat and external equaliser connection for expansion valves. Insulation shall be terminated in such a manner that it will not be damaged during removal of bolts, covers etc. Separate covers similar to flange covers shall be constructed to facilitate easy removal.

The design pressure shall have a reasonable margin over the maximum working pressure.

C. Evaporator Cooling Coil

The cooling coil shall be direct expansion type with multi-row deoxidised copper tubes with aluminium fins. Air velocity across the coil shall be limited

to 2.5 m/sec. The coils shall be pressure tested and thoroughly dehydrated before assembling.

The coil shall be placed to make the system draw through type. Refrigerant feed control shall be by electronic expansion valve. Temperature control shall be through microprocessor based control panel. Insulated condensate drain pan of SS construction shall be provided within the unit.

The unit shall be factory assembled, wired, with inter connecting refrigerant piping and built-in microprocessor based control console and tested as per the relevant code.

The cooling coil shall be to produce the capacity required under specified coil condition and air quantity. Heat load calculation to check the system selection shall be carried out and submitted by the tenderer.

D. Evaporator Fan

The fan shall be heavy duty DIDW centrifugal type statically and dynamically balanced with forward/backward curve blade, directly driven by high efficiency EC motors. Fan wheels and casing shall be constructed of steel and mounted on steel shaft. The bearings shall be ball bearing type mounted on vibration absorbing rubber mounts. The fan motor shall be mounted within the cabinet. Motor horsepower shall be sized for 120% of the rated power required.

The supply fan shall be sized to deliver the required air quantity against the total external static pressure required for the system application, after taking care of all internal static pressure requirements of the units.

E. High Efficiency Filter

A set of High efficiency filters will be located inside the PAC unit cabinet. The filters shall be high efficiency of 99% down to 5 microns. The filters shall be of cleanable type construction of reinforced glass fiber or cotton fabric or fabric-like material sandwiched in between two galvanized wire netting arrangement in a uniformly corrugated form to increase the surface area.

The filters shall have G.I. frames of adequate thickness suitable for long use in an industrial plant. The filters may be in panels of size about 600 x 600 for easy handling them.

The filter panels shall be mounted on the ladder type angle iron holding frames. The frames shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters. Face velocity of air across the filters shall preferably not exceed 1.5 m/sec.

F. Humidifier

The humidifier shall be of Electrode type and shall be placed inside the PAC unit cabinet. The humidifier shall be electronically controlled through the built-in microprocessor based control panel of the unit. A provision of make-up water connection with the humidifier shall be kept with the Unit cabinet.

G. Electric Strip Heater

The PAC unit will be provided with built-in electric strip heater electronically controlled through the built-in microprocessor based control panel of the unit.

Such control includes both operating and safety controls with the sense of air temperature at the RA path and at the downstream side of the heater respectively.

H. Casing and Cabinet

All components shall be housed in a welded sheet metal cabinet of double skin of not less than 22 G thick MS powder coated sheets. The gap between two skins is filled up with at least 25mm thick PUF/ EPS insulation. Different sections will be constructed with framework and connected with each other in an airtight manner through gaskets, thermal barriers and sealant.

Removable panels shall be constructed of framed 1.6 mm sheet steel with angle iron framing. Units shall be provided with 316 L.S.S. fasteners for easy removal and access for servicing. Air handling section of evaporator shall be provided with an acoustic lining of 25 mm thick fiberglass covered with fiber glass cloth and perforated aluminium sheet on the inside surface of the unit casing.

The return air opening shall be on the front face with a matching grille of same colour finish.

6.12.02 Air Cooled Precision Air Conditioners

A Compressor

The compressor shall be hermetically sealed scroll type medium speed, single acting type designed for R-407C/410A duty. The compressor shall be complete with crank case heater (to be energised when compressor is on off cycle).

The compressor shall have proper lubrication system. Safety devices viz. high-pressure switch, low-pressure switch, low oil pressure (if applicable) shall be provided and such devices shall be electronically operated. Manual reset on safety cut out shall be provided. The horsepower for the compressor motor shall be adequately sized or 110% of the rated power required for the unit including drive loss.

Capacity control shall be devised by providing at least two compressors.

B Condenser (Outdoor Unit)

The Condenser shall be of Air Cooled type and shall be constructed of copper tube with aluminum fins. Tubes shall be designed for a minimum working pressure of 30 kg/ sq. cm. The condenser shall be complete with

fans with drive motors and shall be provided with charging connection, safety relief valve and standard accessories, all encased in a powder coated GI casing with built-in electrical items and supporting frame. The condenser shall have the matching capacity with the compressor. There shall be a provision of isolating switch for the fans.

C Evaporator Cooling Coil

The cooling coil shall be direct expansion type with multi-row deoxidised copper tubes with aluminium fins. Air velocity across the coil shall be limited

to 2.5 m/sec. The coils shall be pressure tested and thoroughly dehydrated before assembling.

The coil shall be placed to make the system draw through type. Refrigerant feed control shall be by electronic expansion valve. Temperature control shall be through microprocessor based control panel. Insulated condensate drain pan of SS construction shall be provided within the unit.

The unit shall be factory assembled, wired, with inter connecting refrigerant piping and built-in microprocessor based control console and tested as per the relevant code.

The cooling coil shall be to produce the capacity required under specified coil condition and air quantity. Heat load calculation to check the system selection shall be carried out and submitted by the tenderer.

D. Evaporator Fan

The fan shall be heavy duty DIDW centrifugal type statically and dynamically balanced with forward/backward curve blade, directly driven by high efficiency EC motors. Fan wheels and casing shall be constructed of steel and mounted on steel shaft. The bearings shall be ball bearing type mounted on vibration absorbing rubber mounts. The fan motor shall be mounted within the cabinet. Motor horsepower shall be sized for 120% of the rated power required.

The supply fan shall be sized to deliver the required air quantity against the total external static pressure required for the system application, after taking care of all internal static pressure requirements of the units.

E. High Efficiency Filter

A set of High efficiency filters will be located inside the PAC unit cabinet. The filters shall be high efficiency of 99% down to 5 microns. The filters shall be of cleanable type construction of reinforced glass fiber or cotton fabric or fabric-like material sandwiched in between two galvanized wire netting arrangement in a uniformly corrugated form to increase the surface area.

The filters shall have G.I. frames of adequate thickness suitable for long use in an industrial plant. The filters may be in panels of size about 600 x 600 for easy handling them.

The filter panels shall be mounted on the ladder type angle iron holding frames. The frames shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters. Face velocity of air across the filters shall preferably not exceed 1.5 m/sec.

F. Humidifier

The humidifier shall be of Electrode type and shall be placed inside the PAC unit cabinet. The humidifier shall be electronically controlled through the built-in

microprocessor based control panel of the unit. A provision of make-up water connection with the humidifier shall be kept with the Unit cabinet.

G. Electric Strip Heater

The PAC unit will be provided with built-in electric strip heater electronically controlled through the built-in microprocessor based control panel of the unit.

Such control includes both operating and safety controls with the sense of air temperature at the RA path and at the downstream side of the heater respectively.

H. Casing and Cabinet

All components shall be housed in a welded sheet metal cabinet of double skin of not less than 22 G thick MS powder coated sheets. The gap between two skins is filled up with at least 25mm thick PUF/ EPS insulation. Different sections will be constructed with framework and connected with each other in an airtight manner through gaskets, thermal barriers and sealant.

Removable panels shall be constructed of framed 1.6 mm sheet steel with angle iron framing. Units shall be provided with 316 L.S.S. fasteners for easy removal and access for servicing. Air handling section of evaporator shall be provided with an acoustic lining of 25 mm thick fiberglass covered with fiber glass cloth and perforated aluminium sheet on the inside surface of the unit casing.

The return air opening shall be on the front face with a matching grille of same colour finish.

6.12.03 Non-Duct able Split Type Air Conditioning Units

A. General

- I. The split type room air conditioner consists of two units one Indoor unit (Evaporator) & an Outdoor unit (Condenser). It will be complete with all components to perform filtering and cooling of air in all seasons except winter. The refrigerant condenser will be air-cooled. The unit will be suitable for wall mounting.

- II. The unit shall have normal rating capacity as per the schedule mentioned elsewhere in the specification measured at a room temperature 24 °C DB and RH not exceeding 65% under design outside conditions specified elsewhere. The capacity variation should not be more than 5%.

B. Indoor Unit

- I. The indoor unit consists of panel type dry filter, cooling coil, evaporator fan etc.
- II. The filter is panel type dry having an efficiency of 90% down to 10-micron size Particles. The filter media shall be designed to hold dust, sand and prevent it from being dislodged by vibration or other cause and passing through filter. The face velocity of air across the filters shall not exceed 2.5 m / sec.
- III. Cooling coil will be direct expansion type made of seamless copper tubes with aluminum fins, number of fins as per manufacturer's standard but not more than 13 per inch & R22. The coils should be located at the suction side of the Evaporator Fans. Velocity of air across the coils shall be limited to 2.5 m/sec.
- IV. Piping accessories like Hot gas piping, cold gas piping and liquid refrigerant pipeline all made of copper complete with at least 26 mm thick Aluminium foil faced Nitrile rubber / XLPE or equivalent insulation interconnecting indoor and outdoor units, liquid line valves, liquid refrigerant piping, gauges and instruments, filter-drier, moisture indicator, isolating valves etc., shall be provided as may be required for safe and trouble free operation.
- V. The evaporator fan shall be Centrifugal, DIDW with forward Curved blades directly driven by TEFC squirrel cage induction motor operating in AC 240 V $\pm$ 10%, 1 Ph, 50 Hz $\pm$ 5% supply, with 3- step speed control. The evaporator fan shall be both statically and dynamically balanced.
- VI. Sheet metal casing with inspection facilities, made of Powder coated M.S. sheet and complete with suitable refrigerant pipe connections, insulated drain pan, insulated drain piping, supply and return air opening with decorative grilles with automatically swiveling louvers (for supply air grilles). The casing should be insulated inside to prevent condensation. This shall be provided from inside surface to limit the noise.

C. Outdoor Unit

- I. The outdoor unit shall consist of a compressor, air cooled condenser with liberally sized aluminium finned copper tube coil and low noise directly driven fan and totally enclosed weather proof motor housed in power coated MS casing.

- II. The Compressor shall be rotary type with R-22 refrigerant of specified capacity & motor. The compressor assembly shall be adequately designed for minimum vibration and noise disturbances. The compressor rotor assembly shall be dynamically balanced. The shaft seal shall be of proven design. The horsepower for the compressor motor shall be sized for 115% of rated power required for the unit including the drive loss.
- III. Accessories like Suction and discharge valves, safety valve, HP and LP cut out switches, powder coated sheet metal casing, vibration-isolating device, foundation bolts, built in Electricals like starters, switch fuse units, relays, contactors. The speed of the compressor should not exceed 1500 rpm.
- IV. Air-cooled condenser with directly driven axial flow fan & adequately sized drive motors (TEFC squirrel cage Induction type) with relief valve, hot gas connection, charging connection with valve, louver at the intake & exhaust of air, and other standard accessories. The condenser fan shall be both statically and dynamically balanced.
- V. The heat exchangers shall be designed for a minimum design test pressure of 20.33 Kg/m² on the refrigerant pipe. The design pressure shall have a reasonable margin over the maximum working pressure. Tube supports of adequate strength shall be provided to prevent the tubes from sagging and vibrating. The condensers shall be designed to provide at least 4°C sub cooling of refrigerant under rated design condition. The unit should be operating free from any vibration and noise.
- VI. The piping will be thermally insulated wherever required such that there is no condensation on the outside of the piping. The insulation will be of Aluminium foil faced XLPE or Nitrile rubber or equivalent.
- VII. Refrigerant piping shall be either of M.S. seamless (as per IS-1239, Part-I heavy grade) or copper tube (IS-5493) or ASA-9-31.5). Pressure drop in hot gas, liquid and suction lines should not exceed the value corresponding to 2 °F change in saturation temperature of the refrigerant. Velocity in the discharge and suction pipe of the refrigerant shall not be so high as to create undue vibration and noise, velocity in the vertical length of discharge and suction pipe of the refrigerant shall be high enough to carry the entrained oil in the refrigerant, even in case of unit running at lowest partial capacity. Instrument piping for gauges, switches etc. shall be of copper only.
- VIII. All the above equipment along with the electrical items like starter, contactor and other controls shall be encased in a powder coated MS casing. The casing shall be complete with supports fabricated out of MS angles, & sheets (duly painted), anchor bolts, nuts etc. The entire unit shall be installed with rubber pad type vibration isolators.

IX. All refrigerant valves as may be applicable shall have steel or brass body with flange connection or socket connection for welding or brazing to pipe. For copper pipes size 5/8" and below flare connection will be acceptable. It is preferable to have the stems of rising stems inside screw type. The valve body and bonnet connection shall have bolted or welded connection.

X. It is preferable to have Teflon gland packing for the valves. The construction of the discs of the valves shall be either globe or angle type. The valve seat shall have white metal lining or any equivalent soft replaceable lining. The valves shall be of tested quality. Leak tightness of the valves shall be tested at minimum 1.5 times the design pressure for the system.

6.13.00 **Fresh Air System**

6.13.01 For critical areas like control room, control equipment room etc., outside fresh air will be inducted into the AHU room/ PAC room through a Fresh Air system consisting of an inlet louver, dry panel type filter, a fan with a short duct (if necessary), SA register and mixed with the return air in AHU room/ PAC room.

For other non-critical areas like service building fresh air will be inducted in the AHU room through the wall mounted rain protection cowl with bird screen and a volume control damper.

6.14.00 **Miscellaneous Items**

6.14.01 Heater

A. Strip heater

I. Heating equipment wherever required shall be electrical type. All frame members, control box cover and associated sheet metal parts are to be heavy gauge steel with corrosion resistance treatment. Heating equipment may be required for winter heating as well as for reheating. Reheating heaters may be used for winter heating also.

II. Electric heaters will be fin-tube type of specified KW rating, with fins permanently brazed to metal sheath. The metal sheath and fins will be of G.I. sheet material.

III. Wherever electric heaters are installed in the ductwork, size of ducts should be suitably increased to offset the additional resistance created by the heaters. All heaters shall be mounted on such insulators that there shall be no leakage current under all weather condition including high humidity operation. The mounting frame shall be suitably grounded by earth wires / earth leads of two points.

IV. An air stat is to be installed such that in case there is no circulation of air over the heater coils the heaters will be de-energised. Wherever the heaters are installed in the ductwork the terminal block will be such positioned in a junction box that it will be outside the ductwork in an accessible position. The junction box will be vermin proof, rat proof and provided with a hinged cover. A caution plate as per I.E. rules will also be provided. Access door will be provided in the duct near the heating coil for easy inspection and removal / replacement / fixing of individual strip heaters. The capacity of heaters will be distributed over three phases.

V. In case of reheating the heater will be controlled by humidity sensor & humidity transmitter and in case of winter heaters it will be controlled by temperature sensor & temperature transmitter.

B. Electric Room Heater

Electric Room Heaters shall be with High / Low control.

Electric Room Heaters shall be suitable for AC 240 V $\pm$ 10%, 1 Ph, 50 Hz $\pm$ 5% supply.

6.14.02 Electrode Humidifier

A. Electrode humidifier consists of high temperature Polypropylene water tank, electrodes, auto flash cycle activated on demand from the microprocessor based control system with humidity sensor, located in the AHU / PAC room. Such Humidifier shall be controlled by its own stand-alone microprocessor based control panel. Alarm indication will be provided for low water level in the water tank.

B. Whenever the relative humidity of the conditioned space reaches the minimum allowable percentage of humidity, the humidifier shall be energized to restore the relative humidity. The humidifier shall be such controlled that it shall not exceed the maximum allowable limit of relative humidity in the conditioned space. The humidifier shall be sized and designed accordingly.

6.14.03 Non Chemical Water Treatment Equipment

A. The water treatment equipment is a 1 M long pipeline, which once installed, stops the formation of scale in the heat exchange zones completely.

B. The water treatment equipment consists of Metal Cell and Core and is installed on line after the pumps and before the heat exchange zone. The distance of the heat exchange zone should not be more than 30 M and there should not be any static area between the water treatment equipment and heat exchange area.

6.15.00 False Ceiling

6.15.01 Scope

The work under this Section shall include the supply and installation of suspended ceiling using GYPSUM boards together with the suspension system as shown on drawing or specified in Schedule with all materials labour and equipment. The work shall also include providing of openings in the ceiling for lighting, air conditioning diffusers etc. as shown on drawings or instructed by the Engineer.

6.15.02. Installation

A. Suspension System

General

Suspension system shall consist of the grid supporting the ceiling panels, intermediate runner supports for the grid if any and hangers, wall angles etc. required to suspend the grid or the runners from structural walls, slabs and beams or trusses.

All members of the suspension system shall be of sufficient strength and rigidity to carry the ceiling boards or sheets in a true and level plane without exceeding a deflection of 1/360th of their span. All joints in ceiling panels shall run straight and cross joint shall be securely fixed to walls. All drillings of structural concrete or welding to steel for installation of the suspension system shall be included in the rate. All M S sections used for supports etc. shall be given one coat of synthetic enamel paint over a coat of red lead primer.

Metal Grid Suspension System

Aluminium grid ceiling system shall be "Beadlock" as manufactured by W A Beard shell and Co. Pvt. Ltd. or approved equal. Steel grid ceiling system shall be jolly snap grid as manufactured by Anil Hardboards Ltd. or approved equal.

Angle cleats or other suitable fixing device shall be fixed to the structural beam or slab above for fixing of hangers. Main runners shall be hung by MS flats, angles or 12 g or heavier galvanized tie wire hangers at maximum 1.2 centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system. The spacing of main and cross runners shall be as shown on drawings.

The cross tees shall intersect main runners in pattern shown on drawing and positively looked together with intersection clips. All perimeter areas shall have angle mouldings fixed to vertical wall surfaces & end tees shall rest on the moulding, unless otherwise shown on drawings.

B. CEILING PANELS

Installation of Ceiling panels shall be strictly as per manufacturer's instruction.

For exposed grid ceiling system, tile hold down clips shall be used at the rate of minimum one per 1.2 meter length of perimeter. These shall however be omitted in access panels which shall be located as per the instruction of the Engineer.

For concealed grid ceiling system, tiles shall be fixed to the supporting grid in manner shown on drawing or as specified by the manufacturer. Where V-joints in tiles are called for in drawings, these shall be in true lines. Where flush surface is required, the joints shall be filled with approved filler material and finished to give a neat uniform surface. Where shown on drawings and

schedule of items, 6 mm thick cement: lime: sand surface of ceiling boards and finished in a true and even surface without undulations suitable for subsequent painting. Special care shall be taken to neatly finish the ceiling at junctions with walls, light fixtures, diffusers etc.

6.15.03 Acceptance Criteria

Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance, free from sags, warps, figures or damaged boards. Joints, exposed grids etc. shall be in true lines and symmetrically placed in manner shown on drawings. Cut outs for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations.

6.15.04 Rates

Shall be lump sum rates for complete items called for in the "Schedule of Items". No extra payment will be made for arrangement for lighting fixtures, air conditioning diffusers, access panels, etc. The rate shall include all cutting and wastage from standard size sheets, boards, runners, etc.

6.16.00 **Electrical Items**

6.16.01 General Electrical Specification

For detailed General Electrical Specification, relevant Electrical section, as applicable, shall be followed.

6.16.02 Drive Motor

For detailed technical specification of motors, relevant Electrical section, as applicable, shall be followed.

6.16.03 Local Push Button Station (LPBS)

For detailed technical specification of Local Push Button Station (LPBS) system relevant Electrical section, as applicable, shall be followed.

6.16.04 Power Distribution Board

For detailed technical specification of Power Distribution Board relevant Electrical section, as applicable, shall be followed.

6.16.05 Cables

For detailed technical specification of Cables relevant Electrical section, as applicable, shall be followed.

6.16.06 Cable Trays and Racks

For detailed technical specification of Cable Trays relevant Electrical section, as applicable, shall be followed.

6.16.07 Grounding

For detailed technical specification of Grounding relevant Electrical section, as applicable, shall be followed.

6.16.08 DDC System

For detailed technical specification of DDC System relevant part of the specification shall be referred to.

6.17.00 **Controls & Instrumentation**

6.17.01 Control System

A. All control shall be electrical / electronic type depending upon the requirement & as specified under the specification.

B. Chilled Water System Controls

All safety controls against high refrigerant pressure, low refrigerant pressure, low oil pressure, high and low voltage, compressor over-load and protection against freezing of the water chiller, low flow condenser cooling water & chilled water shall be provided.

All safety controls against antifreeze protection, pump cavitations, motor protection etc. shall be provided.

Operating thermostat/ temperature sensor sensing outlet water temperature of chiller shall be provided for each compressor. This thermostat/ temperature sensor shall control the liquid line solenoid valve in conjunction with the capacity controller for Screw type. Automatically operated heaters with safety thermostats & automatic unloaded starting device shall be provided for the compressor. Antifreeze thermostat to trip off respective compressor shall be provided for each compressor.

C. Direct Expansion System Controls

All devices for automatic refrigerant flow control by thermostatic expansion valve sensed by the superheat in suction line, solenoid valves in the liquid line to operate in conjunction with automatic capacity control of compressor by room thermostat (as applicable) sensing from the inside temperature of the

conditioned space is to be provided. High pressure and low-pressure cut out, low oil pressure cut out (if applicable), high and low voltage protection, compressor motor overload protection shall be provided. Automatically operated crank case heater with safety thermostats shall be provided for reciprocating compressors.

D. Air Handling Unit Controls

The temperature of all conditioned spaces shall be maintained / controlled by a modulating type 3 way mixing valve. The modulating motor will be operated by getting sense from the temperature sensor and associated transmitter placed in the return air path. There shall also be control valves in the chilled water line (for chilled water units) for manual control of chilled water flow into the cooling coil. These control valves shall be flow regulating cum measuring type with precision adjustment arrangement.

E. Annunciations

Audio-visual alarm facility is envisaged of the system. Details of the annunciation system shall be as per mentioned elsewhere and as per requirement.

6.17.02 Miscellaneous Instruments

- A. The pressure indicators and temperature indicators shall have minimum 150 mm size dial. The pressure gauges shall be Bourdon type and complete with isolating/valves. The pressure gauge shall conform to IS: 3624 and temperature gauge as per BS: 1041.
- B. Water flow switch shall be vane actuator type or differential pressure type, with adjustable actuation set point. The level switch shall be ball float operated magnetic type complete with cage. The switch case shall be weather proof conforming to NEMA-4.
- C. Apart from the thermostat, pressure switches, level switches and level indicators specified in this tender document, the local instruments shall also be furnished as a part of the system as shown in drawings enclosed and as per functional requirement.
- D. The range of controls and instruments should be such that the operating ranges are preferably in the mid scale. The accuracy should not be less than + 1% of full scale deflection. The repeatability of readings shall be + 1%. The differential in controls should be such that the equipment is able to operate at desired settings or maintain desired condition.
- E. The scale of pressure indicators for refrigerants units will be in kg/cm². Saturation temperature of the refrigerant in use, at the corresponding

pressure should also be indicated in the scale. The suction and oil gauge shall be compound gauge. The scale of pressure indicator for pumps will be in meter. The temperature indicator's scale will be in °C. The range should be such that even when the equipment is idle and the temperature of the medium is at such variance, the indicator will not be damaged.

- F. All instruments should be such selected and installed that they are easily readable from the floor.

7.00.00 SPECIAL TOOLS

The supplier shall furnish a complete set of all special tools, wrenches etc. with necessary toolboxes as required for erection, operation & maintenance, overhaul or complete replacement of any equipment supplied under this specification. The supplier shall enclose a list of such tools recommended by them.

8.00.00 SPARE PARTS

- 8.01.00 The supplier shall furnish and quote the Mandatory spare parts for the complete Air Conditioning System Equipment as per the list attached in the other part of the specification.

9.00.00 TESTING AND INSPECITON AT MANUFACTURER'S WORKS

- 9.01.00 The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with the requirement of the applicable codes.
- 9.02.00 Following tests shall be carried out during and after completion of different component parts as applicable and in accordance with the requirements of the applicable codes.
- 9.03.00 Material analysis and testing shall be carried out.
- 9.04.00 Hydraulic test for pressure parts including piping of VAM & its components, pumps, compressors & its components, vessels etc.
- 9.05.00 Dynamic balancing of all the rotating parts is to be done.
- 9.06.00 Performance test of Vapor Absorption Chiller, pump, compressors, condenser, cooling towers and air handling units shall be done as per code procedure.
- 9.07.00 Tests on motors as per Indian Standard IS-325 and IS-4029.
- 9.08.00 Other tests, as necessary and recommended by the manufacturer.

Test certificates and reports shall be made available to the Purchaser / Engineer on the above tests, for approval and before despatch of equipment.

The representatives of Purchaser / Engineer shall be given full access to all tests. The Tenderer shall inform the Purchaser within 21 days prior to important shop tests so that if the Purchaser / Engineer so desires, their representatives can witness the tests.

Cost of conducting all shop tests shall be borne by the supplier.

10.00.00 FIELD TEST

10.01.00 Overall performance of the air conditioning system with peak summer and monsoon outside conditions as well as individual equipment shall be tested after complete installation at site. Duration of such test shall be 72 hours. This test shall be carried out to determine whether the plant meets the performance requirements specified here in and shall include measurements of all parameters under various outside conditions and establishment of correct supply of equipment. All testing and calibrating instruments required for this purpose shall be supplied by the contractor.

10.02.00 Inspection and testing of duct work

All component and duct work supplied shall be subjected to inspection and testing as per relevant codes and standard.

10.03.00 All ductwork shall be carefully examined to determine their performance with the specification with respect of dimensions, materials, marking, leakage, workmanship and other requirement.

10.04.00 The contractor shall give assistance for all site tests of the equipment according to prescribed procedure laid down by the Manufacturer / Engineer.

11.00.00 PERFORMANCE GUARANTEE, TOLERANCE, PENALTY AND RECORDS

11.01.00 The Tenderer shall have to guarantee the performance of individual equipment. The Tenderer shall also guarantee maintenance of the inside conditions as indicated under "design criteria".

11.02.00 Rectification of Deficient Performance

If the shop / site performance tests indicate the failure of the guaranteed performance of the equipment concerned, the tenderer will be given sometime to make good the deficiency at his own cost by incorporating the necessary modification, alteration and replacement.

11.03.00 Test Records

The certificates and records of the above mentioned tests should be submitted to the Purchaser for approval. The manufacturer shall maintain records of all tests required in the specification for at least 5 years. A list of records shall be submitted to the Purchaser on completion of the job. The Purchaser shall be able to obtain certified copies of such records at any time.

12.00.00 SPECIAL CLEANING, PROTECTION & PAINTING

12.01.00 Internal surface of all parts shall be cleaned to remove loose scale and dirt. The external surface of the motor and end shield shall be sand blasted to remove all rust, scale etc. All sharp edge shall also be removed. Welded rods, studs and other foreign objects shall be removed prior to final assembly. Excess oil and grease shall be removed by wiping.

12.02.00 All parts shall be painted with two (2) coats of rust preventing paint. One (1) coat of final paint shall be applied over and above the rust proof paint before despatch of material.

12.03.00 All equipment shall be boxed / crated or otherwise protected for shipment. Dry nitrogen desiccant and other protection shall be provided as may be necessary.

13.00.00 DOCUMENTS, DATA TO BE FURNISHED WITH TENDER PROPOSAL

13.01.00 Beside submitting the enclosed Proposal Exhibit Sheets duly filled in, the proposal shall also include the following drawings, curves and information wherever applicable.

Preliminary cooling and heating load calculation is to be furnished.

13.02.00 Preliminary equipment layout drawings of the air conditioning plant room, AHU room and preliminary ducting layout drawing are to be furnished.

13.03.00 Manufacturer's catalogue and literatures incorporating outline and sectional drawings and ducting data for the following equipment:

Screw Compressor
Water-cooled Condensers
Chiller
Air Handling Unit (Fan, cooling coil & filter)
Drive motors for various equipment as applicable
Condenser cooling & chilled water pumps
Cooling tower
Non chemical water treatment

Water-cooled precision air conditioner
Air-cooled precision air conditioner
Air-cooled Non Duct able Split Air-conditioner
Fan Coil Unit
Motor
Direct Digital Controller

13.04.00 Manufacturer's selection chart for the following equipment:

Water-cooled Screw Chiller
AHU
Water-cooled precision air conditioner
Air-cooled precision air conditioner
Air-cooled Non Duct-able Split Unit
Pump
Cooling Tower
Fan
Fan Coil Unit

13.05.00 Manufacturer's catalogues and literatures on air conditioning system, instruments and controls.

13.06.00 Sectional drawings for air diffusers and grilles, as applicable.

13.07.00 Manufacturer's data sheets for filters and refrigerant.

13.08.00 Drive list

13.09.00 A detailed experience list about supply for system of similar type for similar application mentioning in each case the salient technical parameters, date of commissioning and name of customers.

13.10.00 A comprehensive write-up and / or brochure on details of manufacturing and testing facilities in the shop of the manufacturer.

13.11.00 Any other relevant data and particulars.

14.00.00 **POST AWARD DOCUMENTS, DATA TO BE FURNISHED**

14.01.00 Description of the system offered.

14.02.00 Sizing calculations for all equipment and accessories which include cooling and heating load calculations, system pressure drop calculations, duct sizing calculations, pump capacity calculation, calculations for AHUs/FCUs and fresh air fans.

- 14.03.00 Particulars of drawings, data, instruction manual and Drive List.
- 14.03.01 Equipment layout drawing for
- Packaged Screw Chiller
 - Air conditioning plant room
 - Air handling unit room
 - Cooling Tower
 - Pump
 - Expansion Tank
 - Make-up Water Tank
 - Water-cooled precision air conditioner
 - Air-cooled precision air conditioner
 - Air-cooled Non Duct-able Split Unit
 - Fan Coil Unit
- 14.03.02 Schematic flow and instrumentation diagram of the complete system indicating the limits of supply and erection.
- 14.03.03 Ducting layout drawing showing the details of duct sizes, duct joints, duct insulation, duct supports, diffusers, grilles, dampers etc.
- 14.03.04 Layout drawings showing the route of Steam piping, refrigerant piping and cooling water piping with details of insulation hangers, supports etc.
- 14.03.05 Outline drawings incorporating all principal dimensions, civil foundation drawings and weight etc. and also sectional drawings incorporating data of material of construction wherever applicable for following equipments:
- Water-cooled Screw Chilling Unit
 - Air handling unit
 - Water-cooled precision air conditioner
 - Air-cooled precision air conditioner
 - Air-cooled Non Duct-able Split Air conditioner
 - Drive motor for above equipment as applicable
 - Cooling tower
 - Expansion tank
 - Make-up Water Tank
 - Fan coil unit
- 14.03.06 Drawings and data sheets of each of Equipment and Instruments.
- 14.03.07 Drawings and data sheets for air filters, refrigerant / filter drier.
- 14.03.08 Write up on system interlock and / or interlock block diagram.
- 14.03.09 Electrical schematic and wiring diagram for control panel and the system as applicable with back-up write-up.
- 14.03.10 Control panel / Switchgear outline drawings, bill of instruments and drawings showing construction of control panel / switchgear.

- 14.03.11 Reflected False Ceiling Plan indicating detail of supports/ hangers, grids, fixing detail of Grilles and diffusers and lighting fixtures etc.
- 14.03.12 Fixing/ application detail of under deck insulation indicating type and thickness and weight of insulation.
- 14.03.13 Other drawings and data.
- 14.03.14 Material test certificates.
- 14.03.15 Shop test reports and certificates.
- 14.03.16 Operation, maintenance and overhauling manuals shall be provided as per following specification.

OPERATION AND MAINTENANCE MANUAL

The successful tenderer, shall prepare, during the project execution stage a manual giving details of operation and maintenance instructions. The manual will be comprehensive manual and will be provided by the Engineer. The manual shall cover but not limited to the following aspects:

- i) Equipment description with design particulars.
- ii) Installation and Maintenance Instruction including preventive maintenance requirements.
- iii) Instruction for pre-commissioning check-up, operation.
- iv) Trouble shooting.
- v) Spare Parts list.
- vi) Lubricant and lubrication schedule
- vii) Control logic and inter connection and calibration of controls.
- viii) System description
- ix) Necessary drawings, illustration
- x) List of manufacturer's name and catalogues
- xi) Safety instructions.

The manual shall be securely bound in hard back durable folder with proper indexing and separators.

15.00.00 List of Drawings

Sl. No.	Drawing No.	Description
01.	13A06-003-DWG-VA-001	Schematic Diagram of Package Screw Chiller Unit
02.	13A06-003-DWG-VA-002	Schematic Diagram of Water Cooled Precision Air Conditioner
03.	13A06-003-DWG-VA-003	Schematic Diagram for Common Chilled Water Type Air

		Conditioning System of Power House and Service Building
04.	13A06-003- DWG-VA-004	Schematic Diagram of Air Cooled Precision Air Conditioner
05.	13A06-003- DWG-VA-003	Schematic Diagram of Air Cooled Split AC Unit


VIVEK KUMAR - SA Khan - Praveen Kishore



TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
AIR-CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-410-553-A001

VOLUME II B

SECTION C2-B

REV. 00

DATE: APRIL 2015

SECTION: C2-B

GENERAL TECHNICAL REQUIRMENT


VIVEK KUMAR
SA Khan Praveen Kishore

GENERAL TECHNICAL REQUIREMENTS


VIVEK KUMAR
SA Khan Praveen Kishore

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SECTION-IV

GENERAL TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.

1.02.00 Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 The plant will be designed in compliance with applicable National and International Codes and Standards such as ASME, ASTM, DIN, BS, IEC, IEEE, IS, etc. Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Explosives Act, Indian Factories Act, Indian Electricity Act, Environmental Regulations, etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Contractor.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern.

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Contractor proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Contractor to advise Owner of the resulting effect.

1.06.00 Successful Bidder to furnish two (2) sets of latest of national/inter-national codes and standards to owner.

2.00.00 RESPONSIBILITY FOR DESIGN

2.01.00 The Contractor shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.

- 2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.
- 2.03.00 The successful bidder shall have to carry out surge analysis, BFP transient analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.
- 2.04.00 The Bid shall include a detailed discussion on the development status of, and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.
- 2.05.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.

3.00.00 **NAME PLATES (RATING PLATES)**

- 3.01.00 Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.
- 3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.
- 3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.
- 3.04.00 The size and location of nameplates shall be subject to Approval of the Engineer.

4.00.00 **SAFETY AND SECURITY**

- 4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and

- property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.
- 4.02.00 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.
- 4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.
- 4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.
- 5.00.00 **GUARDS**
- 5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.
- 5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.
- 5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.
- 5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.
- 5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

6.00.00 LOCATION AND LAYOUT REQUIREMENTS

The majority of plant and equipment (excluding steam generator and some other auxiliaries) shall all be of indoor installation. A broad list of buildings housing such equipment is given elsewhere in this specification. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner/Engineer finds the proposal more attractive in terms of techno-economic consideration.

While developing the layout of buildings the following criteria shall be given effect :

- a) The minimum width of clear access corridors around equipment shall be 1.2 meter.
- b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.
- c) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of 2.5m shall be maintained between the floor and any overhead piping/ cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.
- d) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.
- e) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified

elsewhere in this specification shall be complied with.

- f) All rail/road crossings for pipe/cable racks shall be done with minimum 8 meters headroom from top of rail/road to bottom of rack. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II.
- g) Cubicle for operating personnel shall be located at safe place near the equipment.
- h) Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or on cable trestle except where approved by purchaser/consultant. In exceptional case, small stretch of outdoor run of interplant cable routing may be taken through cable trench only with the Employer's prior approval.
- i) Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered to. Any departure from this suggestive layout is primarily not recommended.

7.00.00 **OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS**

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

7.02.00 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.03.0 Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings.

No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided.

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

7.04.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common

components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.00.00 **MATERIALS**

8.01.00 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

8.02.00 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Owner to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

8.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.00.00 **LUBRICATION**

9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.02.00 Non ferrous capillary tubing shall be used throughout.

9.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

9.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

9.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

9.06.00 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.

10.00.00 **LUBRICANTS AND CONTROL FLUIDS**

- 10.01.00 The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of the unit.
- 10.02.00 The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.
- 10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.00.00 **OPERATION AND MAINTENANCE**

- 11.01.00 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimised.
- The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.
- 11.02.00 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.
- 11.03.00 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.
- 11.04.00 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.
- 11.05.00 On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.
- 11.06.00 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.00.00 **PLANT LIFE AND MODE OF OPERATION**

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations.

The allowable stresses shall be reduced so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall discuss this aspect in his technical proposal.

The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

The expected start-ups should be considered as minimum
(Based on HPT metal temperature)

Cold start-up (>72 hrs. shutdown)	:	6 per year
Warm start-up (between 10 to 72 hrs. of shutdown)	:	40 per year
Hot start-up (less than 10 hrs. shutdown)	:	160 per year

13.00.00 **PACKAGING & MARKING**

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. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below :

a)	Width of the Package (from centre-line of rails - 1.6 metres on both sides)	:	3.2 Meters
b)	Height of the package from rail top	:	4.47 Meters

The above indicates the dimensions which can be normally transported on the

wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/ site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services of the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.

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. Each package shall be accompanied by a packing note (in weather proof paper) 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.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

14.00.00 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of

piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.00.00 **ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT**

15.01.00 **Environment Protection**

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulate any other conditions not specified hereunder while clearing the project shall be complied with the plant by the contractor.

15.01.01 For Liquid Effluent

- a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A : Effects of Environmental (protection) Rules 1986, as amended till date.
- b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

15.01.02 For Air Emission

- a) Suspended Particulate Matter i.e. dust burden at chimney outlet - Maximum 50 mg/Nm³ (with worst coal and one field out at TMCR).
- b) NO_x - 365 ppm Max. or 750 mg/Nm³ (Equivalent NO₂).
- c) SO₂ - Concentration based standard 2000 mg/Nm³. Load based standard 0.2 metric tonne /MWe/day (for first 500 MW and 0.1 metric tonne/MWe/day for rest of the capacity above 500 MW)

In absence of Indian Standard for emission from power plants as on date, for certain gaseous effluents, the internationally accepted World Bank Standard is to be followed. Indian Standard for emission of power plants are under formulation. Should this standard is published before finalisation of the contract, the bidder has to comply the more stringent of the above norm or the new Indian Standard.

The bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

15.02.00 **Noise Level Requirement**

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

- a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.
- b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.
- c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.

16.00.00 **INSPECTION AND TESTING**

16.01.00 **Inspection and Tests during Manufacture**

16.01.01 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

16.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

16.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

16.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the

consultant for record purpose.

Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library / record.

16.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Owner's Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer along with Defect Map.

16.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to despatch from place of manufacture.

16.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material or any other test as required by approved QAP/ Material specification.

16.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure or as required by design code of that part, for a period not less than one hour.

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

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

16.01.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

16.02.00 **Performance Tests at Site**

- 16.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.
- 16.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.
- 16.02.03 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.
- 16.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

17.00.00 TRAINING OF OWNER'S PERSONNEL

The Contractor shall extend all possible assistance and co-operation to the Purchaser regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.

Number of man-days of training as mentioned below shall be included in his Tender.

17.01.00 Training at Contractor's Premises

The Contractor shall conduct training of sixty (60) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contractor.

The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up :

Discipline	No. of Engineers	No. of Man-month
Operation	20 heads	20
Maintenance Boiler, Turbine, Mechanical	20 heads	20
Electrical Maintenance	8 heads	4
Control & Instrumentation	8 heads	4
Maintenance Planning	4 heads	2
	-----	-----

60 heads

60

However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Purchaser.

The Contractor shall be responsible for the development of the Training Module and Programme Schedule which shall be submitted to the Purchaser for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Purchaser upon completion of the training. An evaluation shall be jointly undertaken by the Contractor and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to:

1. Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.
2. Plant operation and systems training for operators including simulator training as applicable.
3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

Said training programme shall be submitted to the Purchaser for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

The Contractor shall provide qualified English speaking instructors and training

coordinator(s) during the tenure of the training programme.

17.02.00 **Operation and Maintenance Training at Site**

The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the first Unit.

The following instructors shall be at the Site continuously during the training :

- a) One (1) for Steam Generator and Auxiliaries ;
- b) One (1) for Turbine Generator and Auxiliaries ;
- c) One (1) for Electrical Works ;
- d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;
- e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).

17.03.00 **On-the-Job Training**

During the period of pre-commissioning, commissioning and trial operation, the Purchaser shall provide operation and maintenance personnel to assist the Contractor in the operation and maintenance of his supply and work under the direction of the Contractor for the purpose of on-the-job training.

The Purchaser shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Contractor shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

17.04.00 For detail C&I training refer to Volume-VI, Section-9.

18.00.00 **DEVIATIONS**

The Bidder is required to submit with his proposal in the relevant schedules a detail list of any and all deviations taken by him clearly without any ambiguity. In the absence of such a list it will be understood and agreed that the Bidder's proposal is based on strict conformance to this specification and no post-contract negotiations would be allowed in this regard.

Unless otherwise specifically indicated in the deviation list, it will be construed and agreed that details indicated in documents & drawings furnished by the Bidder along with the offer is in-line with the specification requirement.

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

- a) International Standards Organisation (ISO).
- b) International Electro-technical Commission (IEC).
- c) American Society of Mechanical Engineers (ASME).
- d) American National Standards Institute (ANSI).
- e) American Society for Testing and Materials (ASTM).
- f) American Institute of Steel Construction (AISC).
- g) American Welding Society (AWS).
- h) Architecture Institute of Japan (AIJ).
- i) National Fire Protection Association (NFPA).
- j) National Electrical Manufacturer's Association (NEMA).
- k) Japanese Electro-technical Committee (JEC).
- l) Institute of Electrical and Electronics Engineers (IEEE).
- m) Federal Occupational Safety and Health Regulations (OSHA).
- n) Instrument Society of America (ISA).
- o) National Electric Code (NEC).
- p) Heat Exchanger Institute (HEI).
- q) Tubular Exchanger Manufacturer's Association (TEMA).
- r) Hydraulic Institute (HIS).
- s) International Electro-Technical Commission (IEC) Publications.
- t) Power Test Code for Steam Turbines (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).


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- x) Electric Power Research Institute (EPRI).
- y) Standards of Manufacturer's Standardization Society (MSS).
- z) Bureau of Indian Standards Institution (BIS).
- aa) Indian Electricity Rules.
- bb) Indian Boiler Regulations (IBR).
- cc) Indian Explosives Act.
- dd) Indian Factories Act.
- ee) Tariff Advisory Committee (TAC) rules.
- ff) Emission regulation of Central Pollution Control Board (CPCB).
- gg) Pollution Control regulations of Dept. of Environment, Govt. of India
- hh) Central Board of Irrigation and Power (CBIP) Publications.
- ii) The Air Prevention and Control of Pollution Act.
- jj) The Environmental Protection Act
- kk) The Public Liability Insurance Act.
- ll) The Forest Conservation Act
- mm) The Wildlife protection Act.
- nn) The EIA Notification, 1994.
- oo) IS: 14665-Specification for Electric Traction Lift
- pp) Any other statutory Codes/Standards/Regulations


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ANNEXURE-II

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

ITEM	SPECIFICATION REQUIREMENT
A. Site conditions to be considered	
1. Prevalent wind direction	See wind-rose in plot plan. Also refer Metrological Data.
B. Layout Requirements	
1. Maximum permissible slope in	
a) Rail track	1 in 400
b) Road	1 in 30
c) Sides of unpaved embankment	1 in 2
2. Required road width	
a) Main roads	Refer VII-A, B, C.
b) Auxiliary interconnections	Refer VII-A, B, C.
c) Road to the power house unloading bay :	
• Only for entry to the unloading bay	Yes
• To pass through the unloading bay	No
3. Required minimum horizontal distance between the nearest points of	
a) Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b) Electrical transformer and any other building/facility	As per the Tariff Advisory Committee/ LPA Rules
c) Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee/ LPA Rules
d) Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code

ITEM	SPECIFICATION REQUIREMENT
4. Required minimum vertical clearance	
a) Under pipes/cable racks at road crossings	8.0 Metres
b) Soil coverage over underground pipes	1.0 Metre (minimum)
5. Railway Wagon clearance	Rules of the Indian Railways
6. Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres
7. Required level, above the local developed grade level, of	
a) top of all roads	150 mm above FGL
b) all outdoor paved areas	100 mm above FGL
c) Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes
d) Green belt around power plant area	As per environmental guidelines of MOEF, Govt. of India.

BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS

- A. Minimum clear space required at all working and walking areas for operating & maintenance personnel
- Horizontal, in all directions
 - Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C. 1200 mm
 - Adjacent to any other plant facilities (including walls/structures) 1000 mm
 - Vertical (head-room clearance)
 - Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items. 2.5 Metre
 - Under any other plant facilities (including structures, pipes etc.) 2.5 Metre

ITEM	SPECIFICATION REQUIREMENT
3. For all areas where any equipment (including trucks, trolleys and other material handling equipment) will move or maneuver.	Minimum 500 mm clear in all direction from the outer edges of the equipment
4. Minimum clear hand space required for	
a) The application of thermal insulation	100 mm
b) Welding work	150 mm
c) Bolt tightening	150 mm
B. Floors, platforms, staircase, ladders, walls, doors & windows	
1. Statutory Requirement	As per the regulations of Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.
2. Operation & Maintenance Requirement	
a) Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.	Yes
b) Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.	Yes
3. Plinth level of all buildings, above the finished grade level	500 mm
4. Minimum access opening required (with rolling shutter) for transportation, wherever entry of truck for material handling is envisaged	3.5M wide x 4M high or, more depending upon the equipment size to be handled.


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ITEM	SPECIFICATION REQUIREMENT
C. Other Maintenance Requirement	
1. Generator stator handling In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking /lowering assembly, dismantling of building end walls/structures etc. shall be kept.	Yes
2. Maintenance of the internals/impellers of all important equipment, like boiler feed pumps, feed water heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, cooling water pumps, coal mills, compressors, blowers, heat exchangers, fuel oil pumps, filters etc.	Shall be possible without disconnecting or dismantling any piping/ducting.
3. Overhauling and handling of the casings for the above items	Shall be possible without disturbing/dismantling any piping/ducting not directly connected to them.
4. Crane Approach Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible.	Yes
D. Central Control Room All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.	Yes
The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration. However, as a guide line, following features are given :	
a) False ceiling and false flooring shall be provided.	
b) Uniform height, colouring schemes for cabinets etc. shall be available.	


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ITEM	SPECIFICATION REQUIREMENT
c) The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.	
d) No opening shall be provided from Boiler side.	
e) Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.	
f) Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.	
g) The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.	
h) Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.	
i) Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.	
E. Toilet and drinking water facility	Required in all buildings and on all floors wherever operating personnel are to be deployed.


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TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
AIR-CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-410-553-A001

VOLUME II B

SECTION C2-C

REV. 00

DATE: APRIL 2015

SECTION: C2-C
PERFORMANCE GUARANTEE


VIVEK KUMAR
SA Khan Praveen Kishore

PERFORMANCE GUARANTEES


VIVEK KUMAR

SA Khan

Praveen Kishore

CONTENT

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2.00.00	START-UP, INITIAL OPERATION, RELIABILITY RUN AND PERFORMANCE TESTS
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PERFORMANCE GUARANTEES

1.00.00 PERFORMANCE GUARANTEES, PERFORMANCE/ACCEPTANCE TESTS & LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE

1.01.00 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in this specification. The guarantees are categorised as:

- a) Those which attract liquidated damages, as listed below (Category-"A"). The Bidder shall furnish signed declarations in the manner prescribed in the bid proposal schedules for these guarantees.
- b) Those which do not attract liquidated damages, as listed below (Category-"B"). This guarantee list indicated in this section is not exhaustive and the Owner reserves the right to call upon the Bidder to demonstrate any parameter, operation, etc. of any equipment as specified and as required to meet the duty conditions.

1.02.00 The guaranteed parameters shall be without any tolerance values. The Bidder shall demonstrate all the guarantees covered in various volumes and sections of this specification during Performance/Acceptance test. In case during tests it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modification to make the equipment/system comply with guaranteed requirements. However, if the Contractor is not able to demonstrate the guarantees, even after the modifications within ninety (90) days of notification by the Owner, the Owner will at his discretion :

- i. reject the equipment and recover the payment already made or accept the equipment only after levying liquidated damages as identified in this section for those guarantees which are covered under category "A".

OR

- ii. reject the equipment and recover the payment already made or accept the equipment only after assessing and deducting from the contract price an amount equivalent to the deficiency of the equipment/system as assessed by the Owner, for those guarantees which are covered under Category-B.

1.03.00 All guaranteed parameters shall necessarily be quoted by the Bidder based on the established proven results obtained from similar units in successful operation. Evidence for this shall necessarily include the test codes used, acceptance test results, accuracies of various instruments used for the performance test, details of tolerances, if allowed, etc. While quoting the guaranteed parameters, the Bidder shall keep in view the requirements

specified in the specification especially regarding the reliability, operability and maintainability of the equipment proposed. The Owner reserves the right to evaluate the parameters quoted by the Bidder based on his experience and published material available.

1.04.00 The liquidated damages shall be calculated prorata for the fractional parts of the unit unless stated otherwise.

1.05.00 The turbine generator, boiler, auxiliaries, and all other plant equipment and system shall perform continuously without the noise level (individual or collectively) exceeding the values specified in respective equipment specification over the entire range of output and operating frequencies.

1.06.00 Performance/Acceptance Tests

1.06.01 The performance/acceptance tests for various equipment and systems shall be carried out as specified under the respective equipment specifications and those specified below shall be specifically applicable. All the guarantees shall be tested together as far as practicable.

1.06.02 In case of systems with stand-by equipment the liquidated damages for non-performance will be levied for normal operating number of equipment only. However, for this purpose all the equipment including standby equipment shall be tested and average values arrived at.

1.06.03 For instrument inaccuracies during PG Test, refer subsequent clauses of this section.

1.06.04 For Total Auxiliary Power Consumption, the transformers listed under the respective clauses, shall be taken together for purposes of guarantee and not individually.

2.00.00 START-UP, INITIAL OPERATION, RELIABILITY RUN AND PERFORMANCE TESTS

For the purpose of Taking over of the Plant, the following activities shall have to be completed successfully.

- i) Mechanical Completion
- ii) Preliminary Operation
- iii) Initial Operation
- iv) Reliability Operation
- v) Trial Operation
- vi) Performance Guarantee Tests

2.01.00 Mechanical Completion

- (a) Mechanical completion is defined as the state of readiness of works and completeness of Field Quality checks under the scope of contract to undergo the pre-commissioning checks, followed immediately thereafter by commissioning including preliminary operation, initial operation, reliability operation, performance tests including unit characteristics tests for functional or operational occupation of the

works.

- (b) Mechanical completion shall be deemed to occur when the contract erection/installation/construction and Field Quality check works are completed as per specifications for all equipment / systems including standby. It also include but not limited to the following:
- (i) all installation/erection and Field Quality checks duly carried out and individual protocol viz. erection, FQA (Field Quality Assurance) and commissioning protocol to be signed.
 - (ii) all defects/deficiencies notified by the Purchaser during installation/erection rectified to the satisfaction of Purchaser which, in the opinion of the Purchaser, will not affect the safe operability and maintainability of the works, and
 - (iii) the contract works, in the opinion of Purchaser, subject to sub-clause (ii) above, being fit, sound, safe and operable for undertaking the pre-commissioning checks, preliminary operation, initial operation, reliability operation and performance tests including unit characteristics tests followed by subsequent commercial operation without interruption for reason of defect/deficiency or unfulfilled obligations of the Contractor in the erection/installation work.

2.02.00

Specific Requirements of Mechanical Completion

- (a) Mechanical completion in different disciplines shall be determined based on the following characteristics, signifying the readiness of the works/plants and systems for undertaking the pre-commissioning checks and subsequent preliminary operation, initial operation, reliability operation and performance tests including unit characteristics tests as applicable to the contract works:
- (i) All plant construction/installation in various disciplines, as detailed under (b) below and as applicable to the contract are completed including aesthetic and workmanship and safety aspects, with all installation/construction checks as per specification, relevant codes, standards and practices ensuring conformity to contract and meeting any applicable statutory requirements.
 - (ii) All contractual obligations up to the stage of completion of construction / installation are fulfilled to the satisfaction of the Purchaser.
- (b) All contract works or otherwise ready to be taken into service, or for functional or operational occupation save pre-commissioning/ commissioning checks, preliminary operation, initial operation, reliability operation, performance tests, unit characteristics tests are to be carried out as per approved commissioning procedure submitted by the contractor including but not limited to the following:

- (i) Areas inclusive of all roads, accesses, structures, housings, platforms, walkways, stairs, ladders, safe approach to equipments, safety/ protective guards, covers, hand rails and such items of work are constructed as per specification and approved for use.
- (ii) Drains, sewers, waste disposal channels, vents, chutes, ducts and such works are constructed and connected to treatment and other disposal systems.
- (iii) Equipment and piping in different systems/disciplines with all appurtenances, auxiliaries and accessories along with supporting structures, hangers, mounts, etc., are erected/ installed, supported, anchored, aligned, grouted and adjusted for operating conditions.
- (iv) Electrical power supply, control, communication and lighting equipment along with control panels, control desks, switchgear, local starters and such accessories along with protective systems, interlocks and integral and auxiliary systems are permanently installed, aligned and adjusted, with megger, continuity and specified installation checks duly carried out.
- (v) Cables are laid, routed, supported, dressed, clamped, tagged, ferruled and terminated with clamp terminals designated and all continuity and megger checks duly carried out.
- (vi) Safety/relief valves are calibrated and set to operating conditions and tried out. All safety systems are installed, calibrated, checked and accepted.
- (vii) Plant identification numbers, colour codes, tags, nameplates are duly mounted / painted/affixed.
- (viii) All painting, lining and insulation works are completed with specified checks to the satisfaction of the Purchaser.

2.03.00

Other Prerequisites for Mechanical Completion

The Contractor shall also meet the following prerequisites for mechanical completion:

- (a) Submit a compilation of all reports of shop tests, material tests and various stage inspection establishing total compliance to contract specification in manufacturing items of supply of contract.
- (b) Submission of a certificate by the Contractor in a format agreed by the Purchaser that the contract works have been designed, selected, manufactured, furnished and installed under the full responsibility of the Contractor.
- (c) All erected plants, structures, equipment and systems are maintained and preserved in sound condition and are fit and sound to undertake

pre-commissioning checks and 'tests before commercial operation' for operational and functional occupation immediately thereafter.

- (d) All areas and constructed works are cleared daily upto the satisfaction of the Owner of all construction materials, temporary works, debris, rubbish water and all such impediments to render the contract works safe, sound and operable.
- (e) All safety features and safety equipment are functional.
- (f) Fire prevention and fire extinguishing system in all fire prone areas are to be made functional.
- (g) Any specific statutory approvals pre-requisite to commissioning of the plant are duly obtained.

2.04.00 Preliminary Operation

Preliminary operation shall mean all activities undertaken as part of commissioning after mechanical completion upto commencement of initial operation and shall include mechanical and electrical checkouts, calibration of instruments and protection devices, commissioning of sub/supporting systems covered under the contract.

2.05.00 Initial Operation

Initial operation shall include all operations undertaken as part of commissioning after completion of preliminary operation upto commencement of reliability operation. It shall be the first integral operation of the complete BOP integrated with Boiler, Turbine Generator package covered under the contract and shall include first light up / initial equipment rolling, equipment stretch-out, dry-out no-load / partial load /full loads runs for mechanical / electrical tryout and gathering of operational data, calibration, setting and commissioning of controls systems; and shutdown inspection and adjustment after running trails of the plant under the contract.

During initial operation each and every activity wise commissioning protocols are to be jointly signed by the Purchaser and Contractor commissioning team.

The auto loop control tuning shall continue upto the commencement of 72 hour full load operation of trial run.

The initial operations shall include operation of unit as a whole under normal operating conditions for twenty four (24) consecutive hours at the 100% TGMCR load or twelve (12) consecutive hours for two (2) consecutive days at the 100% TGMCR load unless otherwise agreed to by the Purchaser or restricted by system load conditions. The completion of initial operation will be certified in writing by the Purchaser.

2.06.00 Reliability Operation

- (a) After the initial operations, the plant shall be on reliability operation. During the reliability operation, the Contractor will be allowed to make

minor adjustments as may be necessary, provided that such adjustments do not interfere with or prevent the commercial use of the plant or result in significant reduction of output. The duration of the reliability operation of plant shall be spread over a period of thirty (30) days. The maximum number of interruption attributable to Contractor shall be of four (4) numbers each not exceeding four (4) hours duration. In case either the number of interruptions, attributable to the Contractor, exceeds four (4) or the duration of any of the four (4) interruptions exceeds four (4) hours the reliability test shall be repeated.

- (b) For the period of reliability operation, the time of actual operation shall be counted. In case the duration of actual continuous operation of any of the above modes is discontinued for reasons, which are not due to Contractor's fault or negligence, that particular test would be deemed to have satisfied the reliability operation test. However, should the test be discontinued due to Contractor fault, the test shall be restarted for that particular case.
- (c) Should any failure (other than of an entirely minor nature) due to or arising out of faulty design, materials, or workmanship (but not otherwise) occur in any item of the plant, sufficient to prevent commercial use of the plant, the reliability test period of thirty (30) days shall recommence for that item after the defect has been remedied by the manufacturer/Contractor. The onus of proving that any failure is not due to faulty design, materials and workmanship will lie with the Contractor.
- (d) A 'reliability operation' report comprising observations and recordings of various parameters measured in respect of the 'reliability operation' shall be prepared and submitted to the Purchaser. This report, besides recording the details of various observations during 'reliability operation' shall also include the dates of start and finish of the reliability operation and shall be signed by the representatives of both the parties. The report shall have recordings of all details of interruptions that occurred, adjustments made and any repairs carried out during the 'reliability operation'.

Also a punch list is to be prepared during the reliability test and the defects are to be rectified by the contractor before commencement of 72 hour operation at full load during trial operation.

- (e) Should any failure or interruption occur in any portion of the tests due to or arising from faulty design, materials, workmanship, omissions, incorrect erection, or inadequate instructions by the Contractor's supervisors, sufficient to prevent safe commercial use of the plant, the reliability operation test at the particular load shall be considered void and the reliability test shall recommence after the Contractor has remedied the cause of the defect.
- (f) During the reliability operation all the equipments, Raw/ DM water system and sub-systems, control loops, interlocks and protection including switchyard installations will be in service and change over to standby equipments are to be done on running condition of the unit.

- (g) The 'reliability operations' shall be considered successful, provided that each item of plant can meet the above requirements.
- (h) Upon the completion of 'reliability operations', as soon as practicable, or at such time as may be otherwise agreed to by the parties concerned, the Contractor shall notify in writing to the Purchaser that the Plant is ready for performance tests.

2.07.00

TRIAL OPERATION:

1. On completion of erection of any major items along with its auxiliaries, the same shall be thoroughly inspected by the Contractor together with the TSGENCO's Engineers for correctness and completeness and acceptability for pre-commissioning tests. Though the TSGENCO's Engineers associate themselves with such inspection, the responsibility for declaration for correctness, completeness and acceptability shall rest with the Contractor and the pre-commissioning tests and inspections shall be carried out after such declaration. The pre-commissioning tests to be performed at site as well as necessary documentation and formats for the protocols to be signed during and after the tests shall be prepared by the Contractor taking into account relevant Indian/International/ Manufacturers standard as applicable and finalized by the TSGENCO sufficiently in advance through mutual discussions. On conclusion of satisfactory pre-commissioning tests of each individual equipment, the trial operation of the unit shall start consistent with parameters of the technical specifications.
2. The duration of trial operation shall be for 14 days during which period the unit shall be run from half to full load or any other load cycle mutually agreed to during which period the unit shall run at full load for 72 hours continuously. However, if required, the Purchaser and the Contractor may mutually agree for economical load operation for 48 hours continuously. Any interruption caused by the Contractor up to 24 hours will not effect the period of 14 days indicated above. In case of such interruption occurring for more than 24 hours, the above period shall be extended correspondingly. During the above trial operation the standby auxiliary equipment shall also be run for a minimum period of more than 72 hours during which period the equipment shall run at its rated capacity for a minimum period of 24 hours. Further the above trial operation shall be carried out in full fledged manner with the associated instruments and controls. The unit is deemed to be commissioned on successful completion of the above trial operation.
3. A document shall be prepared on the results of trial operation. This document besides recording of the details of the various observations during the trial run will also include the date of start and finish of the trial operation and will be signed by the representative of both the parties. The document of the trial operation shall have log sheets and all adjustments, repairs, interruptions etc., shall be recorded therein. If any major adjustment is carried out which has been changed from the initial operation value, then the reason for it is to be furnished in the

report in detail.

The Purchaser and the Contractor will observe the plant overall reliability and shall test the equipment runback, rundown, auto start of equipments, CMC function and its reliability, complete automation of the plant system etc.

4. The readiness of the unit for the trial operation shall be intimated by written notice to the TSGENCO after mutual discussions. After receipt of such notice if the trial operation could not be performed or could not be completed due to any reasons not attributable to the Contractor and if the situation continues, the Contractor shall be absolved of the responsibility for the delay and the plant shall be deemed to have been taken over by the TSGENCO at the end of 60 days after the Contractor's notifications of readiness of the same.
5. The trial operation shall be carried out in compliance with relevant manufacturer's standards and/or relevant Indian/International standards and manufacturer's operation directions before starting them.
6. Defects which are minor in nature and do not endanger the safe operation of the plant, shall not be considered as reasons for not taking over the plant by the TSGENCO. These defects shall be listed in the above mentioned documents and shall be rectified by the Contractor in accordance with the agreement made in this respect.

2.08.00

Performance Tests

- (a) PG test notification to be given by the contractor to the purchaser after COD. The performance tests shall be conducted at site on all major systems by the Contractor. The Contractor's commissioning Engineers shall make the entire plant ready for such tests and assist the Purchaser in operation during the tests. The test shall be commenced after the 'Plant/Equipment' has attained stable operation at the end of 'reliability operation'. The date of commencement of the performance tests shall be as soon as practicable on completion of the 'reliability operation' or as may be mutually agreed upon between the Contractor and Purchaser.

Final trial operation shall be carried out for a period of seventy two (72) hours at 100% TGMCR before 'taking over'.

- (b) **Independent Inspector**

The Purchaser reserves his right to appoint an independent inspector at his own cost as his representative to discuss the test programme, to approve the instrumentation, to witness the tests and to analyze the test results.

- (c) The tests shall be binding on both the parties of the contract to determine compliance of the 'plant'/'equipment' with the performance

guarantees.

- (d) The performance tests shall be carried out to prove the guarantees. The purpose of the performance tests is to check whether the plant meets the guaranteed performances.
- (e) The performance test procedure, the instrumentation to be installed, the instrument accuracy classes, including the definition of the calculation method to be used, the areas of responsibility and the items which specifically require preparation and agreement shall be submitted by the Contractor for review and approval during detail engineering phase. The schematics identifying the guarantee test instrumentation shall be submitted along with procedure. It shall be ensured that necessary test points and spool pieces are installed during the detail-engineering phase and also identified in process and instrumentation drawings. Code of the PG test is to be fixed up during detail engineering stage. The Contractor shall furnish detail test programme during detail engineering stage.
- (f) The performance test instruments shall be of precision type with instrument accuracy limits as required and defined in the applicable performance test codes such that measurement uncertainty does not exceed the values agreed to by the Contractor in the Schedule of Performance Guarantees.
- (g) All test instrumentation for the performance tests as required shall be supplied by the Contractor on loan basis. All costs associated with the supply, calibration, installation and return of the test instrumentation are deemed to have been included in the contract price. The test shall be in accordance with those specified or as per agreed performance test codes. Batch calibration shall not be accepted.
- (h) Any special equipment, tools and tackle required for successful completion of the performance tests shall be provided by the Contractor.
- (i) It is Contractor's responsibility to co-ordinate for carrying out the performance tests. The duration of the test shall be in accordance with the agreed test codes. All other tests to prove the guarantees as indicated in the Contractor's offer shall also be conducted.
- (j) The plant parameters during the performance test shall be adjusted as far as practicable to the guaranteed performance test conditions. The tests shall be conducted to provide guaranteed parameters as defined in the contract.
- (k) Category-B tests are to be completed before Category-A PG test. Protocols are to be signed jointly by the Purchaser and Contractor for each Category-B test.
- (l) **Reporting of Test Results**

- (a) Within two weeks after the conclusion of the performance test,

the Contractor shall submit ten (10) copies of test reports to the Purchaser stating whether the plant passed or failed such test(s), accompanied by sufficient test data and calculations to demonstrate the level of performance attained with respect to each of the tested parameters.

(b) The report(s) shall include as a minimum, the following:-

- (i) Scope
- (ii) Various guaranteed parameters & tests as per the contract.
- (iii) Codes/standards used
- (iv) . Description of the test procedures
- (v) Full schematic diagrams with indication of test instruments locations and identification tags of same.
- (vi) Instrumentation details and calibration.
- (vii) Duration of test, frequency of readings and number of test runs
- (viii) Test logs and summary of test readings used for performance calculations.
- (ix) Full set of correction curves.
- (x) Computation of test results.
- (xi) Sample calculation
- (xii) Performance calculation
- (xiii) Computations to prove measurement uncertainty is within acceptable limits.
- (xiv) Acceptance criteria
- (xv) Any other information required for conducting the test
- (xvi) Conclusions of performance tests.

(m) Within fifteen (15) days of receipt of such test report(s), the Purchaser shall submit a notice to the Contractor stating either:-

- (i) That Purchaser concurs with the information provided in the test report(s), or
- (ii) That Purchaser disputes some or all of the information provided

in the Contractor's test report(s), the areas being disputed, and the levels of performance being disputed.

- (n) If Purchaser concurs with the information in the Contractor's test report(s), the Purchaser shall, within fifteen (15) days of receipt of the test report, provide a written notice to the Contractor accepting the results of the tests.
- (o) If Purchaser disputes any or all of the results contained in the Contractor's test report(s), the Contractor and Purchaser shall meet within fifteen (15) days of the receipt of the Purchaser notice at a mutually acceptable location to review and discuss the dispute.

All the category-B test results are to be computed and to be submitted along with the PG test report for detail study by the Purchaser.

2.08.00 **Notice of Tests**

The Contractor shall issue 21 days notice to the Purchaser of the date after which he will be ready to commence the tests and the Contractor shall commence the tests promptly thereafter.

2.09.00 **Delayed Tests**

- (a) If the tests could be carried out but are being unduly delayed by the Contractor, the Purchaser may by notice inform the Contractor to conduct the tests within 14 days after the receipt of such notice. The Contractor shall conduct the tests on such days within that period as the Contractor may fix and of which he shall issue notice to the Purchaser.
- (b) If the Contractor fails to conduct the tests within such notice period, the Purchaser may himself proceed with the tests. All tests so conducted by the Purchaser shall be at the risk and cost of the Contractor and the cost thereof shall be deducted from the contract price or charged to the Contractor. The tests shall then be deemed to have been conducted by the Contractor and the test results shall be binding on the Contractor.
- (c) **Facilities for Tests on Completion**

Except where otherwise specified, the Contractor shall provide and bear costs for these items, as may be required to carry out the tests on completion.
- (d) **Retesting**

If the plant fails to pass the test (which in the case of performance tests means not achieving the acceptable limits), the Purchaser may require such tests to be repeated on the same terms and conditions save that only reasonable notice of the date and time of such tests shall be required to be given by the Contractor to the Purchaser.


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(e) **Disagreement as a Result of Tests**

If the Purchaser and the Contractor disagree on the interpretation of the test results, each shall give a statement of his views to other within 14 days after such disagreement arises. The statement shall be accompanied by all relevant evidence.

3.00.00

**SCHEDULE OF GUARANTEES WHICH ATTRACT LIQUIDATED DAMAGES
[CATEGORY-A]**

Sl. No.	Plant/ System	Parameter for Performance Guarantee	Liquidated Damages
3.01.00	Plant		
3.01.01	Efficiency of steam generator	Efficiency of the steam generator at 100% & 80% TMCR while firing the Design coal at rated steam parameters, rated coal fineness and rated excess air. (Refer Note-1 for estimation of weightage factor.) Design coal shall be blended coal (50% imported coal + 50% indigenous coal).	As per Volume-I.
3.01.02	Steam generating capacity	Steam generating capacity in T/hr of steam at rated steam parameters at superheater outlet (with any combination of mills working) with the coal being fired from within the range specified.	As per Volume-I.
3.01.03	Turbine Cycle Heat rate	Turbine Cycle Heat rate in kcal/kWh under rated steam conditions, design condenser pressure with zero make up at 100% & 80% of rated load (Refer Note-1 for estimation of weightage factor.)	As per Volume-I.
3.01.04	Output	Continuous output (MW) of 100% TMCR at Generator terminals under rated steam conditions at Turbine Inlet (247 kg/cm ² (a), 565°C, 593°C) and CW temperature of 33°C with 0% make-up with excitation power deducted	As per Volume-I.
3.01.05	Condenser Pressure	Condenser pressure in mm Hg (abs) under VWO conditions, 3% make up, design CW temperature and CW flow.	As per Volume-I.


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Sl. No.	Plant/ System	Parameter for Performance Guarantee	Liquidated Damages
3.01.06	Total Auxiliary Power Consumption	The total auxiliary power consumption for all the auxiliaries of boiler, turbine Generator and turbine cycle equipments required for continuous unit operation at 100% and 80% of rated load under rated steam conditions and at design condenser pressure with 0% make-up. (Refer Note 1, 2, 3 & 4 for the basis of computation of Auxiliary power)	As per Volume-I.
3.01.07	Cooling Tower Cold Water Temperature	Cooling tower cold water at 100% TMCR under rated steam conditions and at design condenser pressure.	As per Volume-I.

Note :

- The weightage factor shall be estimated considering the following:
 - 80% rating for 2000 hrs in a year,
 - 100% rating for 6300 hrs in a year.
- For computation of Auxiliary Power, output measured at Generator terminals minus sent out power measured downstream of Generator Transformer, applicable Losses (No load loss + Load loss+ auxiliary loss for coolers) for Standby Transformers, Unit Transformers and Bus duct losses shall be considered.
- The equipment for auxiliary power consumption to be considered by the bidder shall include the equipment as per Annexure-C of Volume-I as minimum.
- Power consumption for Fire Pumps, Sump Pumps, Elevators, EOT Cranes shall not be considered in the Auxiliary Power consumption estimate.
- Heat Rate of TG Cycle : Maximum 1850 Kcal/kwh with Steam Turbine driven BFP.
- Steam Generator Efficiency : Not less than 85%
- Auxiliary Power Consumption shall be limited to 6% with Steam Turbine driven BFP and NDCT.
- Normal Availability of the Plant : 98% (2% forced outage)
- Plant Reliability : Minimum 95%
- The condenser pressure measurement while conducting the guarantee tests for CI Nos 3.01.03, 3.01.04 and 3.01.05 above shall be measured at 300 mm above the top row of condenser tubes.

4.00.00 **SCHEDULE OF GUARANTEES WHICH DO NOT ATTRACT LIQUIDATED DAMAGES FOR VARIOUS EQUIPMENT WHICH INCLUDE BUT ARE NOT LIMITED TO THE FOLLOWING [CATEGORY-B]:**

4.01.00 **Steam Generator**

4.01.01 Capacity in T/hr of steam at rated steam parameters at superheater outlet (with any combination of mills working as per Owner's discretion) and the coal being fired within range specified, corresponding to 100% BMCR at 33°C CW temperature.

4.01.02 Efficiency in percentage at 100% & 80% TMCR and 27°C ambient air temperature and 60% RH with zero make-up, condenser vacuum of 77 mm Hg(a) or better while firing the Design coal at rated steam parameters at Superheater and Reheater outlet and rated excess air and with any combination of mills working as per Owner's discretion. Design coal shall be blended coal (50% imported coal + 50% indigenous coal).

4.01.03 Air heater air-in-leakage after 3000 hrs. of operation from taking over date. To be demonstrated.

4.01.04 NOx emission

NOx emission from the unit – shall not be more than 365 ppm or 750 mg/Nm³ (equivalent NO₂) at the ESP outlet at 6% excess oxygen.

4.01.05 Mill capacity at rated fineness.

4.01.06 Gas tightness efficiency of Guillotine dampers.

4.01.07 No fuel oil support shall be required above 30% of BMCR.

4.01.08 Performance characteristics of pumps, fans, etc. viz; capacity, head developed etc.

4.01.09 Capabilities of all drives.

4.01.10 Margins on fans. Through operation of single fan at a time.

4.01.11 Equal load sharing of pumps/fans while running in parallel shall be demonstrated.

4.01.12 Run back capabilities.

4.01.13 Ramp/sudden load change withstand capability.

4.01.14 Life of mill wear parts

4.01.15 Furnace Exit Gas Temperature

The Bidder shall demonstrate by direct measurements that the Furnace Exit Gas Temperature (FEGT) at the specified location does not exceed the

specified maximum temperature of BMCR. The test equipment to be used for this demonstration shall be latest, state of the art, to the approval of Owner.

4.01.16 Flue Gas Temperature

The Bidder shall also demonstrate that the flue gas temperature at the entry and exit of various boiler heating surfaces and also the variation across the cross section perpendicular to gas flow do not exceed the values considered for the pressure parts design.

4.01.17 Steam Temperature Imbalance

The Bidder shall guarantee and demonstrate that at SH and RH outlets (in case of more than one outlet) the temperature imbalance between the outlets does not exceed 10°C.

4.01.18 SH/RH Attemperation System

The Bidder shall guarantee and demonstrate that the spray water flow to SH attemperation system does not exceed the value considered for design (to be indicated in the bid) while maintaining the rated SH outlet steam temperature at BMCR. The Bidder shall also guarantee and demonstrate that the RH temperature is maintained at the rated value without any spray water requirement, for the secondary attemperation system, at all loads for which the specified RH steam temperature is required to be maintained at the rated value.

4.02.00 **Electrostatic Precipitator**

4.02.01 Pressure drop across the electrostatic precipitator.

4.02.02 Collection efficiency and outlet dust concentration shall be as per cl. no. 3.01.00 of Section-II in Volume-II-B.

4.03.00 **Turbine Generator**

4.03.01 Turbine Generator-Set Capability

The steam turbine generator unit shall be capable of delivering continuously at generator terminals the output as indicated by the Bidder in the following heat balances detailed out elsewhere with equipment specification submitted alongwith the bid.

- a) Output corresponding to top HP heaters out of operation.
- b) Output corresponding to all HP heaters out of operation.
- c) Output corresponding to VWO flow, at rated steam conditions with condenser CW temperature 33°C & condenser of vacuum 77 mm HgA or better with 0% make-up.
- d) Output corresponding to overpressure operation of the boiler-turbine-generator set, at rated main steam and hot reheat steam

temperature with condenser CW temperature corresponding to
Condenser vacuum of 77 mm HgA or better with zero percent make-up.

4.03.02 Operating Frequency Range

As per the stipulations of Cl. No. 7.06.00 Vol. II-C, Section-I.

4.03.03 Constant Pressure and Sliding Pressure Operation

The constant pressure operation and sliding pressure operation from 30% turbine MCR to VWO condition of the unit in conjunction with the steam generator, HP-LP bypass system and instrumentation & control system shall be demonstrated.

In sliding pressure mode of operation, during quick load increase the idle control valve (s) must respond rapidly to pick up 20% of operating load, so that immediate increase of boiler pressure is not required. The load response capability shall be demonstrated in steps of 5 %.

Change-over from constant pressure mode to sliding pressure mode and vice-versa shall also be demonstrated.

4.03.04 Start-up, Loading, Unloading and Shutdown Capabilities

Start-up, loading, unloading and shutdown characteristics and startup time and loading capabilities for the steam turbine generator and steam generator both operating as a unit for cold start conditions (greater than 36 hours shutdown), warm start conditions (between 8 and 36 hours shutdown) and hot start conditions (less than 8 hours shutdown) under constant pressure and variable pressure mode and suitability for cyclic operation as indicated by the Bidder in the offer and accepted by the Owner shall be demonstrated ensuring the parameters of vibration, differential expansion, etc.

4.03.05 Vacuum Pulling time

Vacuum pulling time from condenser at atmospheric pressure to rated vacuum compatible to start Steam Turbine

4.03.06 Sudden Total Loss of External Load

On occasions, the steam turbine generator system may experience sudden total loss of all external load. Under these conditions, the steam turbine generator unit shall not trip on overspeed but shall continue in operation under the control of its speed governor to supply power for the plant auxiliary load station transformers, while staying within the prescribed permissible limits of steam metal temperature mismatch, exhaust hood temperature, absolute and differential expansion, vibration and eccentricity acceptable to the Owner.

4.03.07 Capacity with Reduced Hydrogen Pressure

Generator shall be capable of operating at reduced capacity at reduced generator hydrogen pressure in accordance with values furnished by the Bidder in his proposal and accepted by the Owner.

4.03.08 HP/LP Bypass Capabilities

- i. HP/LP bypass capacity and capabilities under various modes of operation shall be demonstrated.
- ii. Condenser performance with HP-LP Bypass operating at rated conditions.

4.03.09 Lube Oil Purification System - Capacity and Purity

Lube oil purification system capacity and the purity of purified oil at the outlet of the centrifuge and the outlet of the polishing filter, shall be demonstrated. If purity check is not possible at site, this shall be carried out at Vendor's works.

4.03.10 Extraction and CRH NRVs

Operation of the valves under turbine trip and high water level in the heaters, shall be demonstrated.

4.03.11 The performance of the condenser, i.e., the back pressure achieved at design CW flow and inlet temp. and cleanliness factors, VWO heat load shall be demonstrated.

4.03.12 Temp. of condensate at outlet of condenser shall not be less than saturation temp. corresponding to the condenser pressure at all loads.

4.03.13 Oxygen content in condensate at hot-well outlet shall not exceed the limit prescribed by HEI over the entire load range and shall be determined according to an internationally approved codes/standard.

4.03.14 When one half of the condenser is isolated, condenser capability shall be demonstrated to take at least 60% T.G. load under TMCR conditions.

4.04.00 **Deaerator**

4.04.01 The dissolved oxygen content in feed-water measured at deaerator outlet shall not exceed 0.005 cc/litre at all loads from no load to VWO condition with 3% cycle make-up with normal pressure and overpressure with incoming condensate presumed to be saturated with oxygen (without any chemical dosing).

4.04.02 Free carbon dioxide in deaerator effluent shall be non-traceable at all loads from zero to VWO with 3% cycle make-up with normal pressure according to ASTM standards.

4.05.00 **Power Cycle Pumps**

Performance of each pump (flow, head, vibration, noise, parallel operation) to be demonstrated.

4.06.00 **Automatic On Line Turbine Testing (ATT) System**

Demonstrated without disturbing normal operation.

4.07.00 **Coal Handling Plant**

Refer Cl. No. 10.00.00 in Volume-IV-A.

4.08.00 **Water Treatment System**

Performance Guarantee of Chemical Feed System shall be in accordance with Cl. No. 8.04.00 in Section-IV, Volume-II-B of the EPC Bid Specification.

Performance Guarantee of Condensate Polishing System shall be in accordance with Cl. No. 8.04.00 in Section-VI, Volume-II-C of the EPC Bid Specification.

Performance Guarantee of River Water Pre-Treatment System shall be in accordance with Cl. No. 8.04.00 in Section-I, Volume-III-C of the EPC Bid Specification.

Performance Guarantee of Demineralisation System shall be in accordance with Cl. No. 8.04.00 in Section-II, Volume-III-C of the EPC Bid Specification.

Performance Guarantee of Circulating Water Treatment System shall be in accordance with Cl. No. 8.04.00 in Section-III, Volume-III-C of the EPC Bid Specification.

Performance Guarantee of Waste Water Treatment System shall be in accordance with Cl. No. 8.04.00 in Section-IV, Volume-III-C of the EPC Bid Specification.

4.09.00 **Instrumentation and Control**

The Bidder shall demonstrate that the Instrumentation and Control system meets all the functional/performance requirements, specified in technical specifications.

4.10.00 **Noise Level**

The Bidder shall demonstrate Noise Level of various plants/equipments/systems as per Clause no. 17.02.00 in Section-IV of Volume-II-A.

4.11.00 **Air Conditioning & Ventilation system**

The rating and performance figures of the AC & Ventilation system & equipment as indicated in the respective technical specification shall be guaranteed by the Bidder. In the event of any deficiencies in meeting the guarantees as indicated in the technical specification after conducting the performance test, the bidder shall put all his efforts to rectify the deficiencies or will replace the equipment / accessories to achieve the specified performance parameters within a reasonable time.

PROCEDURE FOR CONDUCTING PG TESTS


VIVEK KUMAR SA Khan Praveen Kishore

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	STEAM GENERATOR
2.00.00	MILL PERFORMANCE WARRANTY
3.00.00	ELECTROSTATIC PRECIPITATOR
4.00.00	TURBINE GENERATOR
5.00.00	STATUTORY REQUIREMENTS
6.00.00	REMAINING PLANT AND EQUIPMENT


VIVEK KUMAR SA Khan Praveen Kishore

PROCEDURE FOR CONDUCTING PG TESTS

1.00.00 STEAM GENERATOR

The performance tests shall be conducted in accordance with the latest version of ANSI PTC 4.0 except for the specific requirements brought out herein below. This test shall be done simultaneously with PG test of Turbine Generator set. During this test, Boiler unit shall be fully on automatic control under steady load condition.

1.01.00 The efficiency tests shall be carried out with the steam generator operating at the guaranteed point condition i.e. corresponding to 100%, 80% Turbine rated loads, or at the agreed loads as near these as possible, with the boiler operating at the rated excess air, rated SH/RH attemperation flows, flue gas temperature, coal fineness, etc. corresponding to the loads on boiler. At control load, the stable and efficient operation of the unit with the rated excess air, rated mill outlet coal fineness, while achieving the rated S/H, R/H steam parameters shall be demonstrated by the Contractor to the satisfaction of the Owner.

1.02.00 For finding out the performance values, two sets of consistent reading shall be taken and the average of the above values shall be considered for the guarantee purpose.

1.03.00 Corrections shall be applied to the tested efficiency, to correct it to the design conditions, for variations in the following parameters only :

- a) Feed water temperature at economiser inlet.
- b) Ambient air temperature
- c) Relative humidity of ambient air.
- d) Hydrogen in coal.
- e) Moisture in coal.
- f) Gross calorific value of coal.

The Bidder shall furnish correction curves, for Owner's approval, covering the expected ranges of variations for all these parameters for the range of coals specified.

1.04.00 In all other aspects, not spelt out above, or in specifications, where ANSI code stipulates agreement between the parties concerned before the test, Bidder shall get these approved by the Owner.

- 1.05.00 No negative tolerance on account of instrument in-accuracies or otherwise shall be allowed on the guaranteed values.
- 1.06.00 Performance tests shall also be conducted to prove the steam generating capacity of the steam generator at rated parameters at stipulated loads.
- 1.07.00 Necessary write ups, schemes, instrument schedules, detailed procedures clearly indicating periods of tests, frequency of observations, etc. shall be prepared and submitted for all the tests for Owner's review and shall be got specifically approved from the Owner within one year of LOI issue.

2.00.00 **MILL PERFORMANCE WARRANTY**

- 2.01.00 Performance testing shall be done on the mill towards establishing its capacity specified at the specified fineness applying corrections for the variations in coal characteristics i.e. HGI, moisture, etc.

- 2.02.00 The Bidder shall guarantee a capacity output not less than the offered value, at each mill outlet, with coal fineness of not less than 70% through 200 mesh and not less than 98% through 50 mesh screen, when grinding coal having specified grindability index, total moisture content including surface moisture, etc. Bidder shall guarantee that the above capacity will be maintained and demonstrated with the originally installed grinding elements in nearly wornout condition as mutually agreed for the purpose of ascertaining wear life of any of the wear parts or when pulveriser grinding elements have successfully completed the specified guaranteed hours of operation as mentioned by the Bidder, whichever is earlier. During the above mentioned operating period of the mill, manufacturer's operation instructions will be followed and mill will be operated with the specified range of coal without any such readjustment that requires a shutdown of the mill or reduction of the load and/or any replacement of any mill wear parts.

For the purpose of testing to demonstrate the capacity, if grindability and surface moisture vary from those given above, the pulveriser measured capacity shall be corrected using the capacity correction curves furnished by the Bidder alongwith the offer. HGI vs grindability factor curve shall be furnished for HGI variations upto a value above which the capacity remains constant.

Capacity guarantee shall be conducted on all the mills. However, should the results of test as conducted above indicate that deficiency in capacity guarantee is observed in case of one or two mills only and that Owner is further, convinced that such deficiency does not occur out of reasons attributable to mill manufacture and supplier, Owner may waive off the requirement of demonstration of capacity guarantee for such mills only.

- 2.03.00 Mill Wear part life guarantee

The Bidder shall guarantee the wear life of all wear parts of the mill when grinding the specified range of coals. For this purpose the wear parts shall be defined as those parts of the mill which are in contact with coal or coal dust and are likely to wear out during the operation of the mill (except for the grinding

media balls). The guarantee shall be demonstrated on each mill during the guarantee trial period (GTP) commencing after establishing successful operation of the mill continuously for a period of not less than 24 hours at or near its guaranteed rated capacity. The guarantee trial period shall be atleast five years or the wear life of any wear part, whichever is higher. The establishment of the guarantee will be based on actual total hours of operation of the mill regardless of the specified range of coal or fuel loading. The mill wear parts shall be considered to have passed their guaranteed operating life when they have demonstrated their capability to meet the full load rated capacity of the mill at the rated power consumption at the end of the guarantee trial period. In case any of the wear parts has worn out to such an extent that either the normal and safe operation of the mill is jeopardised if it is not replaced/repared or its continued use may lead to exposure or wear of other parts which are not meant for the purpose, that part shall be deemed to have completed its life for the purposes of checking the short fall in wear life even if there is no reduction in mill rated capacity and rated power consumption shall be as quoted by the Bidder when grinding the coal having parameters specified in Section-V and achieving the grind fineness of not less than 70% through 200 mesh and 98% through 50 mesh.

The Contractor shall provide to the Owner so as to compensate for the shortfall in wear life for a plant life of 30 years as has been established or the cost of such wear parts based on the prices quoted by him in his offer for spares escalated as applicable for respective items at the discretion of the Owner.

3.00.00 ELECTROSTATIC PRECIPITATOR

- 3.01.00 The performance test on electrostatic precipitator will commence after completion of reliability run along with the testing of Boiler and Turbine. During the interval between the commencement of trial operation and the commencement of performance test only routine maintenance shall be carried out. No physical or chemical cleaning of ESP shall be permitted during this period or immediately before the conductance of the performing tests.
- 3.02.00 The test efficiency shall be based on the overall performance of the electrostatic precipitator over a mutually agreed period of operation under the conditions given in this specification and following the normal operation of the unit including rapping and normal soot blowing and/or warm up guns. Outlet dust concentration of ESP shall be as specified in relevant section under Steam Generator subject to applicable modification adopted by Environmental Department, Government of India, at the time of project execution.
- 3.03.00 The performance tests shall be carried out in accordance with Method-17 of EPA (Environmental Protection Agency of USA) code. The details of the tests shall, however be mutually agreed upon between the Owner and the Contractor.
- 3.04.00 All calibration procedures and standards shall be subjected to the approval of the Owner. The protecting tubes, pressure connections and other test connections required for conducting guarantee test and maintenance testing shall conform to the relevant codes. The Bidder shall fully elaborate, in his proposal, the provisions made to this effect. Method of measurement for all air

leakage test and power consumption test proposed by the Bidder shall be clearly indicated in his offer, and shall be subject to Owner's approval.

4.00.00 TURBINE GENERATOR

4.01.00 The performance test for the turbine generator set will be conducted in accordance with the latest edition of ASME-PTC-6.

For determination of primary flow to the turbine, low beta ratio throat tap nozzle assembly including required machined straight length meeting the requirements of ASME-PTC-6 shall be provided.

4.02.00 The performance tests shall be carried out to determine compliance with the following heat balance conditions :

- a) 100% output under rated steam conditions at condenser CW temperature 33° C and condenser vacuum 77 mm HgA with zero make-up.
- b) 80% MW output under rated steam conditions at condenser CW temperature 33° C and condenser vacuum 77 mm HgA with zero make-up.

4.03.00 The test heat rate under the above load conditions shall be computed as per relevant clause of T.G. Specification.

The performance test shall be carried out with Turbine driven BFPs in service. To account for the conditions during the conductance of the test which do not correspond to the specified conditions, necessary corrections shall be applied.

4.04.00 No tolerance shall be applied to the final test results for testing inaccuracy. For measurement inaccuracies (including instrument tolerance) as ascertained by the Owner from the codes/standards, the test heat rates will be corrected upwardly reflecting the same (e.g. in case of any inaccuracy of 0.1%, the test heat rate will be corrected by 0.1% upwardly).

4.05.00 The tests shall be arranged in a manner such that the Owner's operation is not disrupted. Duplicate test run will be performed at the 100% and 80% unit loads. The test results of corrected heat rate of the duplicate test runs shall agree within 0.25%. If they differ by more than 0.25% a third test shall be run at the same test points. Corrected results of anyone of the three test runs which deviates from the corrected average heat rate of all the runs by more than 0.25%, shall be eliminated, otherwise the results of the test with the highest heat rate figure will be considered.

The test for TG test capacity shall be carried out alongwith the heat rate test. Instrumentation and other details shall comply as above.

4.06.00 Condenser

Performance test for the condenser shall be conducted in accordance with the latest edition of ASME PTC-12.2. The condenser pressure shall be measured at 300 mm above the top row of tubes under VWO condition, 3% make-up and

design CW flow and CW inlet temperature corresponding to guranteed vacuum. The cleanliness factor shall be determined in accordance with the latest edition of ASME PTC-12.2.

4.07.00 Feed Water Heaters and Drain Cooler

Performance test for feed water heaters shall be conducted in accordance with the latest edition of ASME PTC-12.1.

4.08.00 Deaerator

Performance test for deaerator shall be conducted in accordance with the latest edition of ASME PTC-12.3.

The dissolved oxygen content in feed water at outlet of deaerator shall be determined by ASME-D 888. Reference Method A and any recognised modification thereof.

Free carbondioxide content of deaerator effluent shall be measured by APHA method.

5.00.00 STATUTORY REQUIREMENTS

All parameters of plant, equipment & facilities which are under jurisdiction of Statutory Authorities, like MOEF, TPCB etc., shall be guaranteed. Conformance to the performance parameters under statutory requirement is mandatory.

6.00.00 REMAINING PLANT AND EQUIPMENT

For other equipment, plants and systems, the performance test shall be carried out as per the respective equipment specification and the applicable codes.


VIVEK KUMAR
SA Khan Praveen Kishore



TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
AIR-CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-410-553-A001

VOLUME II B

SECTION C2-D

REV. 00

DATE: APRIL 2015

SECTION: C2-D
QUALITY ASSURANCE


VIVEK KUMAR
SA Khan Praveen Kishore

QUALITY ASSURANCE REQUIREMENTS


VIVEK KUMAR
SA Khan Praveen Kishore

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ANNEXURE-I	FORMAT OF QUALITY ASSURANCE PROGRAMME
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VIVEK KUMAR
SA Khan Praveen Kishore

QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 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 Owner's site or at any other place or 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 Owner/Authorised representative after discussions before the award of contract. 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) Documentation control system.
- c) Qualification data for Bidder's key personnel.
- d) 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.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorising release of manufactured product to the Owner.
- l) System for handling storage and delivery.
- m) System for maintenance of records.

- n) 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 format enclosed at Annexure-I to this section for Owners approval
- o) Internal standards, if referred in the quality plans shall generally be compatible with National / International standards and shall be mentioned in the quality plans. Alternatively bidder shall furnish extracts of the internal standards detailing out acceptance norm for the product / material.

2.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

2.01.00 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 Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Authorised representative for approval. Schedule of finalisation of such quality plans will be finalised before award.

Contractor shall furnish list of Manufacturing Quality Plans of major equipments indicating proposed inspection categorisation indicating items that will be offered for Owner's inspection etc and the Field Quality Plans

2.02.00 Manufacturing Quality Plan for all the major equipment will detail out their respective important components, their in-process various tests/inspection & final inspection / tests, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organization. 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 are to be comprehensively documented by Contractor.

Manufacturing Quality Plan for all major equipments/ items will be approved by owner. In these approved quality plans, Owner / Authorised representative shall identify customer hold points (CHP), test / checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work shall not proceed without consent of Owner / Authorised representative in writing. Inspection/ Test reports are to be submitted to owner as specified in final approved Manufacturing Quality Plans.

2.03.00 Field Quality Plans / Procedures for all field activities shall be submitted to

owner for review / approval. These Quality Plans / procedures will detail out, for all equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control organisation, during various stages of site activities from receipt of materials/ equipment at site.

2.04.00 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 Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorised representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work will not proceed without consent of Owner/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and major deviations in the form of Non Conformity Report shall be referred to Owner/Authorised representative for approval and dispositioning.

2.05.00 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/ Authorised representative for "CHP" and "W" points marked in quality plans , and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC). For items which is not under owner's inspection the contractor shall apply for despatch clearance (MDCC) from owner by submitting their internal inspection reports and quality records

2.06.00 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet serial numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.

2.07.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.

2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section - IX (latest edition) or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Contractor's/ Sub-Contractor's works or at site shall be qualified as per ASME Section-IX (latest edition) or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner / his authorised representative or owner approved Third Party Inspection Agency(TPIA). Previously qualified WPS & PQR shall be acceptable if witnessed by owner's approved TPIA.

For welding of pressure parts and high pressure piping coming under IBR purview, the requirements of IBR shall also be complied with.

- 2.09.00 All non-destructive examination (NDT) shall be carried out in accordance with LIST OF STANDARDS FOR REFERENCE as given below in this section.
- The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT for the list major equipments / items identified for owner's inspection shall be properly recorded and submitted for review and approval. Other items not covered under owner's inspection, contractor shall review and approve the NDT results and such reports shall be submitted to owner in the final documentation of the items / equipments
- 2.10.00 All the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Contractor and finalised with the Owner shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalised and approved by the Owner/Authorised representative and form part of the Purchase Order between the Contractor and the Vendor.
- 2.11.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalised with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed.
- Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.
- Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.
- 2.12.00 Quality requirements for main equipment shall equally apply for spares and replacement items.
- 2.13.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.
- 2.14.00 For quality assurance of all civil works refer to the specifications for civil works.
- 3.00.00 **QUALITY ASSURANCE DOCUMENTS**
- 3.01.00 The Contractor shall be required to submit two (2) copies and two (2) sets of microfilms / CDs of the following Quality Assurance documents within three (3) weeks after despatch of the equipment:
- a) Material mill test reports on components as specified by the specification.

- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.
- h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :
 - i) When some important repair work is involved to make the job acceptable.
 - ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

4.01.00 The Owner's Engineer, or his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access inside the workshops, test labs, establishments at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Owner's Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

4.02.00 The Contractor shall give the Owner's Engineer/ Authorized Inspector twenty one (21) days written notice for "CHP" / "W" points of any material being ready for testing by owner' engineer / Authorized inspector. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/ Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection. If owner's Engineer / Authorised Inspector fail to attend the inspection, next mutually convenient date for test shall be agreed with Contractor. Contractor shall, in

no case proceed with the test without owner or his authorized inspectors, unless the witnessing is officially waived and advised Contractor to proceed with the test. Contractor shall forthwith forward duly certified completed test report and a product quality certificate in six (6) copies to owner upon completion of such test.

- 4.03.00 The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract / QAP or other approved quality documents. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract / QAP or other approved quality documents.
- 4.04.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests excluding the test completion date subject to submission of all certified documents related to the test, If the tests are not witnessed by the Engineer/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the owner's Engineer/Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract / QAP or other approved quality documents.
- 4.05.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the owner's Engineer/Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contract / QAP or other approved quality documents. Contractor and shall give facilities to the owner's Engineer/ Inspector or to his authorised representative to accomplish testing.
- 4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, the Contractor shall furnish quarterly inspection programme indicating proposed schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.


VIVEK KUMAR
SA Khan Praveen Kishore

LIST OF STANDARDS FOR REFERENCE

- a) International Standards Organisation (ISO).
- b) International Electro-technical Commission (IEC).
- c) American Society of Mechanical Engineers(ASME)
- d) American National Standards Institute (ANSI).
- e) American Society for Testing and Materials (ASTM).
- f) American Institute of Steel Construction (AISC).
- g) American Welding Society (AWS).
- h) Architecture Institute of Japan (AIJ).
- i) National Fire Protection Association (NFPA).
- j) National Electrical Manufacturer's Association (NEMA).
- k) Japanese Electro-technical Committee (JEC).
- l) Institute of Electrical and Electronics Engineers (IEEE).
- m) Federal Occupational Safety and Health Regulations (OSHA).
- n) Instrument Society of America (ISA).
- o) National Electric Code (NEC).
- p) Heat Exchanger Institute (HEI).
- q) Tubular Exchanger Manufacturer's Association (TEMA).
- r) Hydraulic Institute (HIS).
- s) International Electro-Technical Commission Publications.
- t) Power Test Code for Steam Turbines (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).
- x) Electric Power Research Institute (EPRI).
- y) Standards of Manufacturer's Standardization Society (MSS)

- z) Bureau of Indian Standards Institution (BIS).
- aa) Indian Electricity Rules.
- bb) Indian Boiler Regulations (IBR).
- cc) Indian Explosives Act.
- dd) Indian Factories Act.
- ee) Tariff Advisory Committee (TAC) rules.
- ff) Emission regulation of Central Pollution Control Board (CPCB).
- gg) Pollution Control regulations of Dept. of Environment, Govt. of India
- hh) Central Board of Irrigation and Power (CBIP) Publications


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**ANNEXURE-I
FORMAT OF QUALITY ASSURANCE PROGRAMME**

VENDOR'S LOGO , NAME & ADDRESS		MANUFACTURING QUALITY ASSURANCE PLAN				DOC NO: XXXXX-CAL-QAP-M-0001	
		ITEM : -				REV NO : 0 1 2 3 4	
						DATE :	
CLIENT :				LOCATION :			
PROJECT :				REFERENCE PURCHASE ORDER NO. & DT :			
VENDOR :				REFERENCE APPROVED DATA SHEET :			
SUB VENDOR :				REFERENCE APPROVED DRAWING. NO. :			
ABBREVIATIONS : QAP - QUALITY ASSURANCE PLAN, CR - CRITICAL, MA - MAJOR, MI - MINOR SPEC - SPECIFICATION, TC - TEST CERTIFICATES P - PERFORM w - WITNESS V - VERIFY CHP - CUSTOMER HOLD POINT				AGENCY : 1 - DCPL/PROJECT AUTHORITY 2 - SUPPLIER 3 - SUB-SUPPLIER 4 - MANUFACTURER 5 - THIRD PARTY INSPECTION AGENCY		GENERAL REMARKS 1 THE ITEMS WHICH ARE FALLING UNDER ANY STATUTORY AUTHORITY'S (LIKE I.B.R. ETC.) SCOPE SHALL BE SUBJECTED TO THAT STATUTORY AUTHORITY'S INSPECTION CLEARENCE.	
NOTES: 1. EXACT MATERIAL / PROCESS / INSPECTION / TESTS FOLLOWED BY THE MANUFACTURER SHALL BE SPECIFIED 2. EXACT REFERENCE DOCUMENT/ACCEPTANCE STANDARD SHALL BE SPECIFIED 3. IN CASE SPECIFIED ACCEPTANCE STANDARD / NORMS IS OTHER THAN NATIONAL / INTERNATIONAL STANDARDS . STANDARD / COPY OF THE ACCEPTANCE NORMS FOLLOWED BY THE MANUFACTURER SHALL BE SUBMITTED FOR REVIEW RECORD 4 FINAL INSPECTION DOSSIER SHALL BE PREPARED BY MANUFACTURER & SHALL BE ENDORSED BY INSPECTIONION AGENCY							
Prepared by				Checked by		Approved By	
Revision		R0	R1	R2	R0	R1	R2
DATE							

DEVELOPMENT CONSULTANTS
(e-PCT-TS-K-02-2014-15-Vol. IIA-6&7.doc)

ANNEXURE-II

FIELD WELDING SCHEDULE

PROJECT : FWS NO :
CONTRACTOR : REV NO. :
PACKAGE : FIELD WELDING CODE :
SYSTEM : PAGE NO. :

Sl No.	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method Quantum	NDT Specification Number	Acceptance form ref.	Remarks

The Field Welding Schedule should be submitted for :

- ☐ Pressure Parts
- ☐ Tanks/Vessels
- ☐ Piping
- ☐ Heavy/Important Structural Steel
- ☐ Heat Exchangers
- ☐ Bus Ducts



TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
AIR-CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-410-553-A001

VOLUME II B

SECTION C2-E

REV. 00

DATE: APRIL 2015

SECTION: C2-E
PAINTING SPECIFICATION


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SA Khan Praveen Kishore

TECHNICAL SPECIFICATION
FOR
PROTECTIVE LINING AND PAINTING


VIVEK KUMAR
SA Khan, Praveen Kishore

SECTION-XIII
TECHNICAL SPECIFICATION
FOR
PROTECTIVE LINING AND PAINTING
C O N T E N T S

<u>CLAUSE NO</u>	<u>DESCRIPTION</u>	<u>PAGE NO.</u>
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2.00.00	CODES & STANDARDS	1
3.00.00	GENERAL REQUIREMENTS	2
4.00.00	EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER	4
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SECTION-XIII
TECHNICAL SPECIFICATION
FOR
PROTECTIVE LINING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.

1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

- a) SSPC SP 10 / NACE 2 / : Near White Blast Cleaning
- b) SSPC PA 2 : Measurement of dry film Coating Thickness with magnetic gauges.
- c) ASTM D 4541 : Method for pull off strength using portable Adhesion Tester.
- d) NACE RP 0274 – 2004 : High-Voltage Electrical Inspection of Pipeline Coatings
- e) NACE SP 0188 – 2006 : Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

- f) NACE RP 0169 – 2002 : Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- g) AWWA C 210 – 2007 : Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
- h) IS 3589:2001 Annexure B : Steel Pipes for Water and Sewage Specification.
- i) AWWA C222-2000 : Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.
- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)

3.00.00 GENERAL REQUIREMENTS

- 3.01.00** The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.
- 3.02.00** The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.
- 3.03.00** The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.
- 3.04.00** The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.
- 3.05.00** Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

- 3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.
- 3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.
- 3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.
- 3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.
- 3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.
- 3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.
- 3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti corrosive painting.
- 3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- 3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.
- 3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).
- 3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

- 3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.
- 3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.
- 3.19.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER

- 4.01.00** After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

All factory finished paints shall be touched up at site as required.

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

4.02.00 Surface Preparation

- 4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting to Sa 2-1/2 Swiss Standard before applying the primer.
- 4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.
- 4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.

4.03.00 Painting

- 4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :
- a) Surface preparation shall be done either manually or by any other approved method.
 - b) Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.
 - e) Total DFT of paint system shall not be less than 150 microns.
- 4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed **outdoor** shall be as follows :
- a) Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss Standard.
 - b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
 - e) Total DFT of paint system shall not be less than 300 microns.
- 4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are **buried underground / laid in side a hum e pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

External surface of the pipe, fittings, specialties etc. handling raw water/clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 2000 micron including primer coat.

4.03.04 Specification for application of paints for **internal surface protection of large diameter pipes** (sizes above 600 mm NB and above) if any, shall be as follows :

- a) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.
- b) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.
- c) The minimum dry film thickness (DFT) of internal lining shall be 600 micron.

4.03.05 Specification for application of paints for protection of **internal surfaces of DM Water Storage Tank(s)** shall be as follows :

- a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.
- b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.
- c) Total thickness of primer and paint should not be less than 500 microns.

4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.

4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.

4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

4.03.09 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface Preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 / NACE 2 / Sa2½ of ISO 8501 (near white metal)

- a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.
- b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

- a) Coating shall be applied when
 - i) When the pipe surface temperature shall be atleast 3°C above dew point temperature.
 - ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater than 50°C.
- b) Material preparation shall be in accordance with manufacturer's recommendations.
- c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

- a) PU coating shall be applied when the pipe surface temperature atleast 3°C above dew point temperature (when R.H is more than 85%).
- b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 TEST REQUIREMENTS :

6.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating : Coating thickness shall be in the range of $\pm 20\%$ and as per SSPC PA 2.

6.01.01 Apparatus / Instrument:-

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

6.01.02 Procedures:-

- a) Number of measurements:
For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).
- b) If the structure is less than 300 square feet, each 100 square feet should be measured.
- c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.
- d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet
- e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness. Area measurement must be within specified range.

6.02.00 Electrical Inspection (Holiday) Test

- 6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.
- 6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.
- 6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.
- The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)
- Testing Voltage $V = 7900 \sqrt{T} \pm 10$ percent where T is the average coating thickness in mm.
- 6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.
- 6.03.00 Adhesion Pull off Test :**
- After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.
- 6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:
- A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling "Jaw" at the bottom and also dollies.
- 6.03.02 Prepare the test surface :
- Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.
- 6.03.03 Prepare Dolly (Test Pull Stub) :

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

6.03.04 Select an adhesive:

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 Attach the dolly to the surface.

- a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.
- b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.
- c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.
- d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 Adhesion Test Procedure

- a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.
- b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.
- c) Slide the dragging indicator pin on the black column to zero by pushing it downward.
- d) Firmly hold the base of the instrument in one hand and rotate the handwheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

- e) Read the scale and record the adhesion value.

6.04.00 Coating Repair

Defective Coating shall be repaired in accordance with the following subsections.

6.04.01 Surface Preparation:

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.04.03 Coating Application :

The coating system shall be applied to the prepared areas in accordance with procedure.

6.04.04 Repair Inspection :

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 Welded Field Joints

6.05.01 Preparation :

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

6.05.02 Electrical Inspection :

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

7.00.00 INFORMATION/ DATA REQUIRED

The Bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. and also unit rates for application of each type of paint along with supply shall be furnished.


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TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
AIR-CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-410-553-A001

VOLUME II B

SECTION C3

REV. 00

DATE: APRIL 2015

SECTION: C3

ELECTRICAL SPECIFICATION


VIVEK KUMAR
SA Khan Praveen Kishore

**TELANGANA STATE POWER GENERATION
CORPORATION LTD.
1 X 800 MW KOTHAGUDEM TPS**

AIR CONDITIONING SYSTEM

**TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)**


VIVEK KUMAR SA Khan Praveen Kishore



TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR AIR CONDITIONING SYSTEM KOTHAGUDEM TPS (1 X 800MW)	SPECIFICATION NO.
	VOLUME NO. : II-B
	SECTION: C
	REV NO. : 00 DATE: 23/02/2015
	SHEET: 1 OF 1

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Praveen Kishore
SA Khan Praveen Kishore
VIVEK KUMAR

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR AIR CONDITIONING SYSTEM KOTHAGUDEM TPS (1 X 800MW)	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION: C
		REV NO. : 00 DATE: 23/02/2015
		SHEET: 1 OF 1

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

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR**PACKAGE: AIR CONDITIONING SYSTEM**PROJECT: 1 x 800 MW KOTHAGUDEM TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC (3 Phase, 4 Wire) /240 V AC 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, fibre optical 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 equipments 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 & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR**PACKAGE: AIR CONDITIONING SYSTEM**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
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 but not specified above (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 (excluding power cables) 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.

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SECTION-II

TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS


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CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	CODES & STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	TYPE AND RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENTS
7.00.00	ACCESSORIES
8.00.00	TESTS
9.00.00	DRAWINGS, DATA & MANUALS

ATTACHMENT

ANNEXURE-A	DESIGN DATA


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VOLUME: V-A

SECTION-II

**TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS**

1.00.00 SCOPE

1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.

1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 CODES & STANDARDS

2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/Publications except when otherwise stated herein or in the driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed:

- i) IS-325
- ii) IS-12615
- iii) IEC-60034

3.00.00 SERVICE CONDITIONS

3.01.00 The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00 A.C. Motors

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.


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- 4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.
- 4.01.03 LT motor & HT motor name-plate rating at 50°C shall have at least 15% margin and 10% margin respectively over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification.
- 4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.
- 4.01.05 Motors efficiency class shall be IE1, IE2 as per latest version of IEC-60034.
- 4.02.00 **D.C. Motors**
- 4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.
- 4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.
- Starter panel complete with all accessories shall be included in the scope of supply.
- 5.00.00 **PERFORMANCE**
- 5.01.00 **Running Requirements**
- 5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.
- 5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.
- 5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.
- 5.02.00 **Starting Requirements**
- Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed the given below-
- | | | |
|---------------------|---|---|
| Motors up to 1500kW | - | 600% subject to IS tolerance of plus 20%. |
| Motors above 1500kW | - | 450% not subject to any positive tolerance. |
- 5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.


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- 5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except mill motor. Mill motor shall start with rated load and accelerate to full speed at 85% of the rated voltage at the motor terminals.
- 5.02.03 a) Two hot starts in succession with motor initially at normal running temperature.
b) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.
- 5.02.04 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.
- 5.03.00 **Stress During Bus Transfer**
- 5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.
- 5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 5.04.00 **Locked Rotor Withstand Time**
- 5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.
- 5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
- 5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.
- 6.00.00 **SPECIFIC REQUIREMENTS**
- 6.01.00 **Enclosure**
- 6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.
- 6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.
- 6.02.00 **Cooling**
- 6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).


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- 6.02.02 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.
- 6.03.00 **Winding and Insulation**
- 6.03.01 All insulated winding shall be of copper.
- 6.03.02 All motors shall have class F insulation but limited to class B temperature rise.
- 6.03.03 Windings shall be impregnated to make them non-hygrosopic and oil resistant.
- 6.04.00 **Tropical Protection**
- 6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- 6.04.02 All fittings and hardwares shall be corrosion resistant.
- 6.05.00 **Bearings**
- 6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.
- 6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.
- 6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- 6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.
- 6.05.05 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement.
- 6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
- 6.06.00 **Noise & Vibration**


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- 6.06.01 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.
- 6.06.02 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.
- 6.06.03 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.
- 6.07.00 **Motor Terminal Box**
- 6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation
- 6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.
- 6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.
- 6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.
- 6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.
- 6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.
- 6.07.10 The gland plate for single core cable shall be non-magnetic type.
- 6.07.11 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

Voltage Rating of Motor		Minimum Ph-Ph & Ph-Earth clearance
0.415 kV	:	25 mm
3.3 kV	:	65 mm
11.0 kV	:	140 mm

Note: In case it is not possible to maintain these clearances, the live parts shall be totally insulated from earth and other Phases. Adequate clearances shall be provided for cable connections.

6.08.00 **Grounding**

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Rating		Conductor Size	
Above	Up to		
-----	5.5 kW	:	8 SWG GI Wires.
5.5 kW	22 kW	:	25mm X 4mm GS Flat.
23 kW	55 kW	:	40mm X 6mm GS Flat.
56kW	174kW	:	50mm X 8mm GS Flat.
175kW	ABOVE	:	75mm X 10mm GS Flat.

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 **Minimum Cable Size for LT & HT Motors shall as be as follows-**

a) For 415V, 3-Ph, LT Motors-

Rating		:	Cable Size
Above	Up to		
-----	5.5 kW	:	1R X 3C X 6 Sq.mm
5.5 kW	11 kW	:	1R X 3C X 10 Sq.mm
11 kW	22 kW	:	1R X 3C X 35 Sq.mm
22 kW	37.5 kW	:	1R X 3C X 70 Sq.mm.
37.5kW	55 kW	:	1R X 3C X 150 Sq.mm
55 kW	75 kW	:	1R X 3C X 300 Sq.mm
75 kW	110kW	:	2R X 3C X 150 Sq.mm
110 kW	175kW	:	2R X 3C X 300 Sq.mm

b) For 3.3kV & 11kV, 3-Ph, HT Motors-

Rating		:	Cable Size
Above	Up to		

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175 kW	1000 kW	:	1R X 3C X 240 Sq.mm
1000 kW	2000 kW	:	2R X 3C X 240 Sq.mm
2000 kW	4500 kW	:	2R X 3C X 300 Sq.mm
4501 kW	10,000 kW	:	9R X 1C X 1000 Sq.mm.

Note: During detail engineering if higher cable size is required same shall be provided.

6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

- Temperature rise in Deg.C under rated condition and method of measurement.
- Degree of protection.
- Bearing identification no. and recommended lubricant.
- Location of insulated bearings.

7.00.00 **ACCESSORIES**

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.02.03 Minimum Cable Size for space heater shall be as listed-

- For LT motors: 2.5 sq.mm, 2-Core copper cable complying with IS-1554(Part-1).
- For HT motors: 6 sq.mm, 2 Core aluminium cable complying with IS-1554(Part-1).

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.

- 7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.
- 7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- 7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.
- 7.03.05 0.5 sq.mm annealed tinned copper conductor complying with IS-1554(Part-1). shall be used for RTD/BTD wiring.
- 7.04.00 **Indicator/Switch**
- 7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:
- a) 11000 V and 3300V motor bearing temperature.
 - b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.
- 7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.
- 7.04.03 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.
- 7.05.00 **Current Transformer for Differential Protection**
- 7.05.01 Motor 1000 kW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure.
- 7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.
- 7.06.00 **Accessory Terminal Box**
- 7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.
- 7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner's cable connections.
- 7.07.00 **Drain Plug**
- Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.


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7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

For paint shade finish, refer Section-X of Volume: II-A : Lead Specification.

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition, any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/11kV motors.

- a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
11 kV	49 kV peak

- b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.
- c. Polarization Index Test as per IS: 7816 as routine test
- d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.
- e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.
- f. Test for noise level as routine test.
- g. Test for vibration as routine test.


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- h. Tan delta measurement on coils.
- i. Surge withstand test for inter turn insulation.
- j. Test to diagnose rotor bar failure during manufacture.
- k. Over speed test as routine test.
- l. Temperature rise test.

Temperature rise under normal condition above ambient temperature shall be limited to-

Specified Design Ambient temperature	Thermometer Method	Resistance Method
50 deg.C	60 deg.C	70 deg.C
45 deg.C	65 deg.C	75 deg.C
40 deg.C	70 deg.C	80 deg.C

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **To be Submitted with the bid**

- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write-up on forced lubrication system, if any
- d) Type test report

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.

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ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.V. Supply	11000 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 44 kA symm. for 1 sec.	Motors 1500 kW & above
M.V. Supply	3300 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 40 kA symm. for 1 sec.	Motors 175 kW and Up to less than 1500 kW.
L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz effectively earthed Fault level 50 kA symm. for 1 sec.	Motors above 0.2kW and below 175kW.
(ii)	240V AC/415V AC 240V, 1Ø, 2W, 50 Hz effectively earthed	Motors upto 0.2kW. Lighting, Space heat- ing , A.C supply for Contr- ol & protective devices.
D.C. Supply	220V, 2W, unearthed Fault level 25* kA. for 1 sec.	D.C. alarm, control & protective devices

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

Note-

- 415V or 3.3 kV may be adopted by the bidder for the drives in the range of 160-210 kW.
- 3.3 kV AC supply for CHP conveyor motors of rating above 160 kW is to be used.
- The voltage rating of the drives indicated above is for basic guideline. Minor variations can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.
- Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ reclaimer shall be 415V ac supply only.


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2.0 RANGE OF VARIATION

A.C. Supply :

Voltage : $\pm 10\%$
Frequency : $+3\%$ to -5%
Combined Volt + frequency : 10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage : 187 to 242 Volt


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SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**


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CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENT
7.00.00	ACCESSORIES
8.00.00	TEST
9.00.00	DRAWINGS, DATA & MANUALS

ATTACHMENT

ANNEXURE-A	DESIGN DATA


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SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

1.00.00 SCOPE

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves/dampers.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. All the electrical actuators shall be INTEGRAL type only.

2.00.00 STANDARDS

2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed

i) IS-9334

ii) IS-325

3.00.00 SERVICE CONDITIONS

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.

3.03.00 For actuator motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 RATING

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

- 5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.
- 5.02.00 Attain full speed operation before valve load is encountered and imparts an unseating blow to start the valve in motion (hammer blow effect).
- 5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
- 5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
- 5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

- 6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring.
- 6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy. Degree of protection of enclosure for motor actuator shall be IP-65.
- 6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 **Motor**

- 6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.
- 6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.
- 6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.
- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be with integral starter with 3phase/3wire, 415V AC and operable from remote.




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- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.
- 6.05.00 **Position Indicator/Transmitter**
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, 4-20 mA current signal as position feedback, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. All wiring shall be done with 1100V grade fire resistance PVC insulated stranded copper conductor of not less than 2.5 Sq.mm cross section. All wiring shall be identified at both ends with ferrules. All the electrical actuators shall have uniform wiring.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.
- 7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V control transformer with primary & secondary fuses.

8.00.00 **TEST**

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 **DRAWINGS, DATA & MANUALS**

- 9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **To be submitted with Bid**

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues. Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, BOM, control & schematics, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.


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ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz Effectively earthed Fault level 50 kA symm. for 1 sec.	Motors above 0.2kW upto less than 175kW.
(ii)	240V AC/415V AC 240V, 1Ø, 2W, 50 Hz effectively earthed	Motors upto 0.2kW. Lighting, Space heating , A.C supply for Control & protective devices.
D.C. Supply	220V, 2W, unearthed Fault level 25* kA. for 1 sec.	D.C. alarm, control & protective devices

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage	:	± 10%
Frequency	:	+3% to -5%.
Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242


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TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.
PE-SS-999-506-E101
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SECTION : **D**
REV NO. : **00** DATE : 29/08/2005
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GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

Praveen Kishore
SA Khan Praveen Kishore
Vivek Kumar
VIVEK KUMAR

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
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1.0 INTENT OF SPECIFICATION

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

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

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

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

3.3.3 The following frequency of starts shall apply

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

3.4 Running Requirements

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

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

3.5 Stress During bus Transfer

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

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

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

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

4.0 CONSTRUCTIONAL FEATURES

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

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

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

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

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- 4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.5. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.6. In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.
- 4.7 Terminals and Terminal Boxes**
- 4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.
- Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".
- 4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A E & 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.

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 Design

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

5.0 INSPECTION AND TESTING

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

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

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

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LT MOTORS

A. GENERAL

1. Manufacturer & Country of origin.
(Shall be as per approved QA make)

2. Equipment driven by motor

3. Motor type

4. Quantity

B. DESIGN AND PERFORMANCE DATA

1. Frame size

2. Type of duty

3. Type of enclosure /Method of cooling/Degree of protection

4. Applicable standard to which motor generally conforms

5. Efficiency class as per IS 12615

6. (a) Whether motor is flame proof Yes/No

(b) If yes, the gas group to which it conforms as per IS:2148

7. Type of mounting

8. Direction of rotation as viewed from DE END__

9. Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)

10. Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)

11. Maximum continuous load demand of driven equipment in KW

12. Rated Voltage (volts)

13. Permissible variation of :

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- a. Voltage (Volts)
 - b. Frequency (Hz)
 - c. Combined voltage and frequency
14. Rated speed at rated voltage and frequency(RPM)
15. At rated Voltage and frequency:
 - a. Full load current
 - b. No load current
16. Power Factor at
 - a. 100% load
 - b. NO load
 - c. Starting.
17. Efficiency at rated voltage and frequency,
 - a. 100% load
 - b. 75% load
 - c. 50% load
18. Starting current (amps) at
 - a. 100 % voltage
 - b. 85% voltage
 - c. 80% voltage
19. Minimum permissible starting Voltage (Volts)
20. Starting time with minimum permissible voltage
 - a. Without driven equipment coupled
 - b. With driven equipment coupled

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21. Safe stall time with 100% and 110% of rated voltage
 - a. From hot condition
 - b. From cold condition
22. Torques :
 - a. Starting torque at min. permissible voltage(kg-mtr.)
 - b. Pull up torque at rated voltage.
 - c. Pull out torque
 - d. Min accelerating torque (kg.m) available
 - e. Rated torque (kg.m)
23. Stator winding resistance per phase (ohms at 20 Deg.C.)
24. GD^2 value of motors
25. No of permissible successive starts when motor is in hot condition
26. Locked Rotor KVA Input
27. Locked Rotor KVA/KW
28. Vibration limit :Velocity (mm/s)
29. Noise level limit (dBA)

C. CONSTRUCTIONAL FEATURES

1. Stator winding insulation
 - a. Class & Type
 - b. Winding Insulation Process
 - c. Tropicalised (Yes/No)

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- d. Temperature rise over specified maximum ambient temperature of 50 deg C
 - e. Method of temperature measurement
 - f. Stator winding connection
2. Main Terminal Box
 - a. Type
 - b. Location (viewed from NDE side)
 - c. Entry of cables(bottom/side)
 - d. Recommended cable size (To be matched with cable size envisaged by owner)
 - e. Fault level (MVA), Fault level duration (sec)
 - f. Cable glands & lugs details (shall be suitable for power cable)
 3. Type of DE/NDE Bearing
 4. Motor Paint shade
 5. Weight of
 - a. Motor stator (KG)
 - b. Motor Rotor (KG)
 - c. Total weight (KG)

D. List of accessories.

1. Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)
2. Terminal Box for Space Heater (Yes/No)
3. Speed switch (Yes/No)
No of contacts and contact ratings of speed switch

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4. Insulation of bearing (Yes/No)

5. Noise reducer(Yes/No)

6. Grounding pads

i) No and size on motor body

ii) Nos on terminal Box

7. Vibration pads

i) Nos and size

ii) Location

8. Any other fitments

E. List of curves.

1. Torque speed characteristic of the motor

2. Thermal withstand characteristic

3. Starting. current Vs. Time

4. Starting. current Vs speed

5. P.F. and Effi. Vs Load

F. Additional Data to be filled for each rating of DC Motor

1. Rated armature voltage (Volt)

2. Rated field excitation (Amp)

3. Permissible % variation in voltage

4. Minimum Permissible Starting voltage (volt)

5. At rated voltage

i) Full load Armature current.(Amp)

ii) Full load Field current (Amp)

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- iii) No load Armature current (Amp)
6. Full load Field current (Amp)
7. No load Armature current (Amp)
8. Minimum permissible field current(Amp) to avoid overspeeding at
 - i) Maximum permissible voltage
 - ii) Rated voltage
 - iii) Minimum Permissible Voltage
9. Resistance (indicative Values) in ohm
 - i) Armature winding (Arm + IP + Series) at 25 deg.C
 - ii) Field Winding at 25 deg. C
10. Inductance (indicative values)
 - i) Armature winding
 - ii) Field winding
11. Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at
 - i) 220 V DC
 - ii) 250 V DC
 - iii) 187 V DC
12. Value of the external resistance (ohm) required to be connected in series with armature during starting only
13. Technical data sheet for external resistance box
14. GA drawing of motor
15. Starting time calculation

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16. Starter resistance design calculation
17. Electrical connection diagram of motor


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		QUALITY PLAN SHEET 1 OF 2		CUSTOMER : TSPGCL		PROJECT : 1 X 800 MW KOTHAGUDEM TPS		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
				VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		SPECIFICATION TITLE				
SYSTEM		ITEM : AC ELECT. MOTORS BELOW 55KW (LV)		SECTION		VOLUME III						
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	 Project Engineer
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1	-	
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

	QUALITY PLAN		CUSTOMER TSPGCL			PROJECT 1 X 800 MW KOTHAGUDEM TPS			SPECIFICATION :		
			BIDDER/ :			TITLE			NUMBER :		
	SHEET 2 OF 2		VENDOR			QUALITY PLAN			SPECIFICATION :		
		SYSTEM			NUMBER PED-506-00-Q-006, REV-01			TITLE :			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION VOLUME III		
									P	W	V
1	2	3	4	5	6	7	8	9	10		
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-
NOTES: 1. ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2. WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3. FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SUPPLIER'S SIGNATURE. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY											
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE						BIDDER'S/VENDORS COMPANY SEAL		

		QUALITY PLAN				CUSTOMER : TSPGCL		PROJECT : 1 X 800 MW KOTHAGUDEM TPS		SPECIFICATION : NUMBER :		
						BIDDER/ : VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE :		
		SHEET 1 OF 9				SYSTEM :		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION :		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1 X 800 MW KOTHAGUDEM TPS		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
				VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION :				
SHEET 2 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED  Project Engineer
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	FOI OF 55 MM & ABC  Project Engineer
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1 X 800 MW KOTHAGUDEM TPS			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
		SHEET 3 OF 9		VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA MA	VISUAL TEST	100% SAMPLE	- MANUF'S SPEC.	NO VISUAL DEFECTS MANUF'S SPEC.	INSPT. REPORT LOG BOOK AND OR SUPPLIER'S TC	3 3	- -	2 2	 FOR TIO SH/ THE MOTOR INSULATION THICKNESS MORE THAN S HEIGHT
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2. DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA MA MA	VISUAL MEASUREMENT ELECT. & MECH TESTS	100% SAMPLE -DO-	- MANUF'S DRG. . MANUF'S SPEC./ RELEVANT IS	NO VISUAL DEFECTS (FREE FROM BURS) MANUF'S DRG. RELEVANT IS	LOG BOOK -DO- SUPPLIER'S TC	3 3 3	- - -	2 2 2	
1.9	CONDUCTORS	1. SURFACE FINISH 2. ELECT. PROP. & MECH. PROP	MA MA	VISUAL ELECT. & MECH. TEST	100% SAMPLES	- RELEVANT IS/ BS OR OTHER STANDARDS	FREE FROM VISUAL DEFECTS RELEVANT IS/ BS OR OTHER STANDARDS	LOG BOOK SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3* 3	- -	2* 2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER : TSPGCL		PROJECT : 1 X 800 MW KOTHAGUDEM TPS		SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 4 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	 Project Engineer TSPGCL
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1 X 800 MW KOTHAGUDEM TPS			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :			
SHEET 5 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1 X 800 MW KOTHAGUDEM TPS		SPECIFICATION : NUMBER :				
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 6 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	 3A Khan Project Office 10/11/2024
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	FOR MV MOTOR
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
BIDDER'S/VENDORS COMPANY SEAL												

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1 X 800 MW KOTHAGUDEM TPS		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
				VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION :				
SHEET 7 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	 V. MOHAN Vice Chairman TSPGCL
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
BIDDER'S/VENDORS COMPANY SEAL												

		QUALITY PLAN				CUSTOMER : TSPGCL			PROJECT : 1 X 800 MW KOTHAGUDEM TPS			SPECIFICATION : NUMBER :		
						BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		SHEET 8 OF 9				SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1		
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2		
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1\$	1	\$ NOTE - 2		
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-			
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3		
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2		
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2		
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1\$	1	\$ NOTE - 2		
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3		
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1\$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2		
BHEL			PARTICULARS			BIDDER/VENDOR			Page 224 of 513					
			NAME											
			SIGNATURE											
			DATE											
									BIDDER'S/VENDORS COMPANY SEAL					

		QUALITY PLAN SHEET 9 OF 9		CUSTOMER TSPGCL		PROJECT 1 X 800 MW KOTHAGUDEM TPS		SPECIFICATION :			
				BIDDER/ :		TITLE		NUMBER :			
				VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS
									P	W	V
1	2	3	4	5	6	7	8	9	10		11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY  Witness Signature											
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE						BIDDER'S/VENDORS COMPANY SEAL		

ANNEXURE-I

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

S.No.	LIST OF LT MOTORS
1.	BHARAT BIJLEE LTD.
2.	CROMPTON GREAVES
3.	ASEA BROWN BOVERI
4.	KIRLOSKAR ELECTRIC CO LTD.
5.	NGEF
6.	SIEMENS
7.	MARATHON
8.	GE-POWER
9.	RAJINDRA ELECT INDUSTRIES
10.	LAXMI HYDRAULICS PVT. LTD

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.


VIVEK KUMAR
SA Khan Praveen Kishore

[illegible]

ANNEXURE III

[illegible]

VIVEK KUMAR SA KHAN Praveen Kishore

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

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

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

(A) SYSTEM VOLTAGE CODES:

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

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

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

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

(C) CABLE CODES

PVC Copper

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

PVC Aluminium

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

XLPE Copper

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

XLPE Aluminium

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

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


VIVEK KUMAR
SA Khan Praveen Kishore



TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
AIR-CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-410-553-A001

VOLUME II B

SECTION C4

REV. 00

DATE: APRIL 2015

SECTION: C4

C & I SPECIFICATION


VIVEK KUMAR
SA Khan Praveen Kishore



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WIRE KUMAR
 SA Khan Praveen Kishore



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SPECIFIC TECHNICAL REQUIREMENT

Praveen Kishore
SA Khan
VIVEK KUMAR



**SPECIFIC TECHNICAL REQUIREMENT
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1. **Complete** Control & Instrumentation for Air Conditioning System is in bidder scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder.
2. A common PLC based control system cum Annunciation panel with solid state annunciation windows along with product integrated microprocessor panel for the chilling unit shall be provided for AC and ventilation system by the AC system vendor.
3. The Ventilation system shall be controlled from the common AC system PLC panel. Vendor to ensure necessary provision and hardware requirement in its PLC panel for the Ventilation system. The list of drives/motors/fans/pumps etc., Input/output Lists for ventilation system to be hooked up to the PLC panel and other necessary inputs shall be furnished by the Ventilation system vendor.
4. Bidder to include Field instrumentation along with accessories and Field Junction Box (JB's), in his scope of supply. Each instrument/ equipment shall have a unique KKS Tag no. Field instrument specification and Data Sheet are given elsewhere in this specification.
5. All fields cabling for instruments/motor/pump/blower to JB is in bidder's scope and details are given elsewhere in the specification. The field I/O s should be grouped together in JB's suitably and a common trunk cable shall be taken to the panel. Cable between JB to PLC shall be provided by BHEL as free issue as per 'Electrical scope split sheet' in Electrical portion of the specification whereas cable schedule, cable interconnection details and wiring diagram for the same shall be in bidders' scope.
6. Cable schedule, cable interconnection details and wiring diagram where one end equipment and/or both end equipments are in bidder scope shall be provided by the bidder.
7. Instrument installation drawings are to be provided by bidder. All instrument fitting and erection hardware/racks as per instrument installation diagram shall be in bidder's scope.
8. All manual valves at pump discharge shall be provided with Open and Close Limit Switches.
9. PLC control system as defined in the enclosed specification and Data Sheets shall be in bidder scope. The PLC system shall comprise of (i) PLC based local panel (ii) UPS Power supply (iii) Operator interface in the form of CRT, keyboard and OWS along with required furniture.



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10. PLC shall have the facility to synchronize its time with BHEL plant master clock system using IRIG-B signals. Necessary Hardware (IRIG-B port) for same at PLC end to be provided by bidder. The cable connecting PLC and plant master clock system shall be in BHEL scope.
11. PLC shall be connected to DCS through serial link with OPC Compliant for monitoring/Control. For details, please refer PLC Architecture Diagram.
12. All furniture (tables, chairs etc.) required for PLC operator HMI shall be in bidder's scope. Chairs shall be capable of being adjusted for height and position of backrest. The chairs shall be mounted on five castors, shall swivel and shall have arm rests'. One table and chair shall be provided for each operator station and separate table for each printer.
13. The requirements given below are to be read in conjunction with detailed Technical specification enclosed.
14. For any other cable type, the scope of cable and cable type in 'Electrical scope split sheet' in Electrical portion of the specification shall be final.
15. 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.
16. Supplied system shall provide critical group alarms for both AC and ventilation system to be hardwired to plant DCS.
17. Provision for input fire signal from fire alarm system to be ensured in the PLC panel for opening/ closing of the motor operated fire dampers.
18. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.
19. Provision for earthing of the panel to be provided by vendor.
20. Vendor to submit GA drawing of control panel indicating layout of instruments, construction details, wiring diagram, class of protection for enclosure, paint type, paint color, thickness and material of enclosure sheet, control scheme during detailed engineering.
21. Layout & space requirement of panel to be specified during detailed engineering.



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22. All bidirectional drives (Motor Operated Valves, MOVs) are integral starter type. Typical Hook Up diagram of all types of drives is attached for use(subject to Customer approval).
23. Bidder shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. Also, Cable Interconnections details for Complete System shall be in Bidders' scope.
24. 415 V AC (3 Phase, 3 Wire) supply shall be provided by BHEL at a single point as per 'Electrical scope split sheet' in Electrical portion of the specification. Further distribution to various instruments/Equipment shall be in Bidder's scope. Bidder to include the necessary power distribution board in his scope. Any power supply other than the above, if required for any instrument/equipment has to be derived from the above supply & all the necessary hardware for the same shall be in Bidder's scope.
25. Bidder to provide all control panels, system cabinets, termination & relay cabinets complete with all accessories, wiring and all mounting and erection hardware including junction boxes, canopies, structural steel as required. All instruments/drives shall be terminated on Junction Boxes/Panel in Bidder scope of supply. 20% Spare terminals shall be provided on Junction Boxes.
26. Bidder to delegate/depute their person/experts as per owner/consultant requirements.
27. The make of all the items shall be from approved sub-vendor list.
28. 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 eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE, IS etc.
29. Bidder shall provide the signal exchange, to Plant DCS in BHEL prescribed format to be furnished during detailed engineering.

NOTES:

1. All equipment items shall be of latest design with proven on track record from reputed experienced manufacturers of specified type and range of equipment. The make/model of various instruments/items/systems and instrument sub-



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vendor shall be subject to approval of BHEL/Customer during detailed engineering stage.

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.


VIVEK KUMAR
SA Khan, Praveen Kishore



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

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PLC SPECIFICATION

Praveen Kishore
SA Khan
VIVEK KUMAR

1.00.0 GENERAL

1.01.0 Each of the relevant BOP areas and different auxiliary systems shall be provided with dedicated PLC or proprietary control systems for overall operation and control.

1.01.01 There shall be redundant bidirectional OPC link between DDCMIS network and each Package PLC including PADO for monitoring / performance activities.

1.02.00 These control systems shall conform to high standard of engineering meeting all applicable codes and standard, design and workmanship and shall meet the functional requirements in all respects and shall be capable of performing satisfactorily in continuous commercial operation under the specified environmental condition.

1.03.00 Further this part of the specification details the common technical and functional requirements applicable for all the systems unless specified elsewhere in the specification. Only specific requirements are indicated in this section. However, Bidder shall also adhere to the Section-VI, Subsection A (DDCMIS) of this volume of the specification for other basic and detailed scope & services, philosophy & technical requirements of different hardware and softwares including response time, loading, interface, redundancy criteria, display, logs, spares criteria, drawings and document submission etc.

1.04.00 All local PLCs shall be supplied from one manufacturer for all plants and shall provide single unified hardware and software platform for realizing all the control and monitoring functions.

1.05.00 In general local PLC, Proprietary control system by third party system integrators shall not be allowed and only main PLC/ Proprietary control system manufacturer shall be allowed to do the design engineering, system integration etc. Owner will be the final authority in allowing third party system integrators, if required, for only small applications.

1.06.00 Local control and monitoring facility of the equipments from the respective package control room and local panels is required.

1.06.01 The redundant upper level network of each Package PLC system will be connected to redundant server to be located in Plant Engineer's room. Suitable Fibre optic cable shall be used for redundant interconnections.

1.06.02 The hot redundant Server shall continuously update all the inputs. The switchover to the hot standby Server shall be smooth and bumpless with proper indication to the operator.

1.06.03 Local PLC Workstations shall be capable of programming activities for control systems of the package including set point change, logic build up & modifications, graphics build up & modifications etc.

1.06.04 Programming shall not require special computer skills. On the programming console, it shall be possible to do the programming, self-diagnostics, testing of sequence, simulation and any sequence modification.

1.06.05 Alarm monitoring / reporting, generation of logs, trends, calculations, printing of logs & reports etc. shall be available in local workstations as well as in remote DDCMIS network workstations. In case of failure of DDCMIS network, control and monitoring of the individual packages shall still be possible from the Operator Work Stations in the respective package control room.

1.06.06 The system shall permit carrying out of the on-line dynamic test and self-diagnostic checks while maintaining safe condition and without endangering the safety of equipment without having any influence on the process being controlled.

2.00.00 GENERAL TECHNICAL REQUIREMENTS

2.01.00 Bidders scope of supply shall include , but not limited to , Hot standby local PLC / Proprietary control & monitoring system for each of BOP areas and shall consist of IO cards, remote and Local IO rack, control rack, redundant Power supply modules, redundant communication / networking and interconnection Cables, redundant processor and communication cards, redundant Servers, operator work stations / GUI, LVS(if applicable) , printer, redundant networking hardware etc. , system cabinets ,startup, commissioning, mandatory and recommended spares, drawing, documents and training to owner's personnel at site and at vendors works etc.

2.02.00 All types of programming packages shall be licensed with facility of editing and configuration. For each of the PLC / proprietary control system, the programming software shall be supplied in a laptop for each package preloaded with package in addition to other types of devices such as CD, DAT etc.

2.03.00 In addition to the Operator and/ cum Engineering workstations, Bidder shall also supply LCD screen based display unit, control switches and other operational keys (GUI). Bidder shall also provide minimum of one no. laptop computer for each PLC based package and with latest hardware configuration and loaded with suitable operating, application program including licensed softwares as a backup engineering cum programming and configuration station. **This loaded laptop shall be handed over by Bidder well in advance of FAT to Owner's head office at Hyderabad.**

2.04.00 The System shall allow dependable and effective control of the process equipment and shall be designed for maximum integrity and reliability. Integrity shall be maintained by providing a dual hot redundant system. The System shall have a capability to monitor and take actions for distributed functions from a central location.

2.05.00 The control & Instrumentation shall be through dedicated microprocessor based PLC, Common DDCMIS network, proprietary system for the each of the respective plants covering the total functional requirement of sequence control, regulatory control, interlock & protection, monitoring, alarm, data logging.

2.06.00 The loop cycle time shall be less than 1 sec for close loops and open loops. The switchover from main controller to redundant controller shall be bump less; and shall be within one cycle time i.e. within 50 msec.

2.07.00 Each controller shall have 40% functional capacity to implement additional functional blocks over and above implemented logic / loops under worst loading conditions.

2.08.00 Field Input/Outputs

The System shall meet the following I/O card requirements. The maximum number of inputs / outputs to be connected to each type of module shall be as follows:

a)	Analog input module	8
b).	Analog output module	8
c)	Binary input module	16
d)	Binary output module	16

2.09.00 Communications System

2.09.01 The Bidder shall include a dual hot redundant communication system

2.09.02 The data highway speed shall be 100 Mbps.

2.10.00 Operator Interface

Operator Work Station (OWS) / GUI / LVS shall perform control monitoring and operation of all auxiliaries/ drives. However, Push button stations are also to be provided with RIOs.

2.11.00 Interface with Common DDCMIS system

Each PLC, proprietary control systems shall be interfaced to Common DDC MIS network with bidirectional OPC link. The link shall be redundant.

2.12.00 PLC shall be of latest version and all the modules like Control modules, communication modules, IO modules, and network interface modules etc., modules shall be from the same family of hardwares and softwares and shall be sourced from Bidder's Original Principal's works.

2.13.00 PLC shall have also, but not limited to, the following requirements,

2.13.01 I/O LAN Speed shall be minimum 5 Mbps - 100 MBPS on Deterministic LAN.

2.13.02 I/Os shall be Rack based and not Din Rail Mountable.

2.13.03 Processors and I/Os shall be of same family.

2.13.04 Diagnostics for DI/DO, AI & AO shall be provided.

2.13.05 All PLC I/O Rack Power Supplies shall be redundant. Only Bulk power supply redundancy will not be acceptable.

2.13.06 Processor selection shall be such that it shall never be loaded more than 50% at any time during the operation.

2.13.07 SOE module (if applicable) must stamp and store 250+ events at card level.

2.13.08 PLC shall store tag details and bit word addresses on upload of logic as well as tag descriptions.

2.13.09 Remote I/O Rack outside control room shall be on Fiber Optic communication only.

2.13.10 Processor shall be self learning in case of failure. No need to configure and program replaced processor.

2.14.00 Operating work stations must be Run time license/servers. Client server architecture not acceptable.

2.15.00 Each operator work station must have minimum 150% tags handling capability.

2.16.00 Auto Tuning feature of PIDs at PLC controller level shall be available.

2.17.00 Programming facility shall be available from Remote IO stations.

2.18.00 Processor shall support minimum twice the overall system IO handling capacity in Redundant configuration.

2.19.00 Online editing of Program shall be possible.

2.20.00 Processors shall be Hot back up.

2.21.00 Automatic synchronization of primary processor/controller of PLC with secondary processor/controller.

2.22.00 Bumpless switchover to secondary processor/controller of PLC when the primary fails.

2.23.00 Power supply module redundancy shall be true power supply redundancy

2.24.00 Automatic program and data equalization of primary processor/controller of PLC.

2.25.00 Automatic 'Forcing Bit' update in the secondary processor/controller of PLC when any Forcing is applied in the primary processor/controller of PLC. (Forcing Bit Table of both the PLCs must be automatically synchronised.)

2.26.00 Softwares

The latest version of all necessary applications and networking software shall be supplied for the system. The software tool shall have facility to interface with third party software packages. Window base operating system shall be provided. The system shall be OPC compliant. Easy upgradation and future expansion facility shall be available.

All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant. User shall not have to pay any recurring license fee during the usage period of the system.

It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life.

2.23.00 Redundant Uninterrupted Power Supplies (UPS) shall be provided for each Local PLC.. UPS specification shall be as per requirements indicated in Section V of this specification.


VIVEK KUMAR SA Khan Praveen Kishore

1. SCOPE

This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to site, erection & commissioning, site acceptance test of the PLC Control & Monitoring System comprising PLC Control panel/Remote I/O panel (housing Processors, I/O cards, power supply packs etc.), Operator workstations(OWS), Printers, Annunciation system, UPS, cables and all other equipment and accessories required for completeness of the system as mentioned in different sections of this specification.

2. GENERAL

2.1. The system shall include self-diagnostic features not limited to the following:-

- Memory Faults, both PROM and EPROM
- Processor Faults
- Communication Faults
- I/O interface or address faults
- Voltage signal discrepancy on input and output
- Power supply faults
- Output loop check
- Channel level diagnostics such as fault monitoring, contact bounce filtering etc.
- Failure of main or I/O processor

2.2. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.

2.3. Bidder shall provide all software on CDs along with required software licenses .The original CDs of installed operating & application software shall be maintained by bidder. Software modification and up gradation (as & when required) shall also be covered under the vendor scope without any cost implication.

2.4. PLC programming console shall be provided with industry proven antivirus software with perpetual license (free version not acceptable).

2.4.1. PLC shall conform to IEC: 61131

2.4.2. 25 x 6 mm Copper ground bus to be provided for each panel.

2.4.3. The microprocessors shall be 32 bit, and Hot redundant.

2.4.4. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements.

2.4.5. The standby processor shall be updated automatically in line with the changes made in the working processor.

2.4.6. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions.

2.4.7. Memory shall be non-volatile, preferably EEPROM type. However, in case volatile memory is provided, battery backup shall be provided for a minimum of three months to keep the stored program intact. Battery drain indication shall be provided at least 1 week before the battery gets drained and same shall be annunciated in OWS.

3. PERFORMANCE AND GUARANTEE

The PLC system shall be guaranteed to meet the performance requirement as specified and also for trouble-free continuous operation for 12 months from the date of commissioning or 18 months from the date of delivery at site whichever is later unless specified otherwise in the detailed PLC specification attached elsewhere in the specification.

4. INPUT/OUTPUT MODULES:

Digital input modules shall have the following features:

- 1 Signal isolation (optical)
- 2 Fuse protection
- 3 Contact bounce protection
- 4 Field cable monitoring
- 5 Short circuit protection
- 6 Configurable as status input, latched input
- 7 Alarming of abnormal state
- 8 The interrogation voltage for digital inputs shall be 24V DC.

The number of channels per DI module shall be maximum 16.

Digital output modules shall have the following features:

- 1 Individually fused
 - 2 Individual contact suppression
 - 3 Configurable as momentary , latched or pulse-width modulated outputs
 - 4 Individually definable default state
 - 5 Output read back verification
 - 6 Short circuit protection
- The number of channels per DO module shall be maximum 16.

Analog input modules shall have the following features:

Analog inputs can be 4-20 mA DC, RTD (Pt 100), thermocouple or voltage inputs

- 1 Signal isolation (Galvanic/ opto- coupler)- Galvanic separation shall conform to EN 50020.
- 2 Fuse protection and fuse failure detection
- 3 Transmitter power supply at 24 V DC
- 4 Input filtering for noise level
- 5 Cold junction compensation for thermocouples
- 6 Transmitter monitoring for parity, wire break and limit values
- 7 Monitoring of A/D conversion
- 8 Conversion to engineering units
- 9 Test for normal or extended range
- 10 Detection of open circuit for thermocouples
- 11 Alarm limit testing for high, high-high, low, and low-low substituted values.

The number of channels per AI module shall be maximum 8

Analog output modules shall have the following features:

1. Analog outputs shall be 4-20 mA DC or voltage form.
2. Direct or reverse operation
3. Loop check back of output

4. Default options upon failure

The number of channels per AO module shall be maximum 8.

5. SPARE PHILOSOPHY FOR PLC I/O CHANNELS:

1. Spare I/O channels: All types of I/O modules shall be provided with 10% spare channels. Spare channels shall be wired and shall be distributed among the control processors.
2. 10% hot spare I/O modules (installed) shall be provided.
3. 10% spare slots for I/O modules distributed among the control processors.


VIVEK KUMAR
SA Khan Praveen Kishore



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

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OF

PLC DATA SHEET

Praveen Kishore
SA Khan Praveen Kishore
Vivek Kumar
VIVEK KUMAR

	DATA SHEET FOR PLC SYSTEM		SPECIFICATION NO.: PE-TS-410-	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 18.03.2015
			SHEET 1	OF 1
Data Sheet No.:				
Data Sheet A&B				
DATA SHEET – A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)			DATA SHEET – B FOR PLC SYSTEM (TO BE FILLED BY BIDDER)	
GENERAL	PROJECT	1X800MW KOTHAGUDEM TPS		
	SERVICE	AIR CONDITIONING & VENTILATION SYSTEM		
	QUANTITY	☐ UNITISED ☒ COMMON		
	LOCATION	☒ INDOOR ☐ OUTDOOR ☒ AC ☐ NON-AC*		
PLC EQUIPMENT	MAKE / MODEL NO.	BIDDER TO INDICATE		
	PROCESSOR	REDUNDANT WITH HOT STANDBY		
	DATA BUS (HMI)	☐ COPPER WIRE ☐ FIBRE OPTIC		
	DATA BUS (I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC		
	DATA BUS (REMOTE I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC		
	FIELD CONTACTS INTERROGATION VOLTAGE	☒ 24 V DC ☐ 48 V DC ☐ 110 V AC		
	LOCATION OF COUPLING RELAYS	☐ MCC ☒ PLC PANEL		
	DESKTOP OWS QUANTITY	☐ ONE ☐ TWO ☐ _____ ☒ DESKTOP VERSION ☐ SERVER VERSION ☐ WORK STATION VERSION REQUIREMENT OF OWS IN CCR ☐ YES ☐ NO QUANTITY _____		OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification.  WASEEM KULKARNI
	DESKTOP MONITOR TYPE	☐ 19" ☒ 24" TFT/CRT MONITOR ☐ GIU ☐ OTHERS		
	PRINTER	INKJET ☐ A3 ___ NOS ☐ A4 ___ NOS LASER B/W ☐ A3 ___ NOS ☐ A4 ___ NOS COLOR INKJET ☐ A3 ___ NOS ☐ A4 ___ NOS COLOR LASER ☒ A3_1_NOS ☐ A4 ___ NOS		
PROGRAMMING / CONFIGURATION FACILITY	A) ☐ HAND HELD ☒ LAPTOP B) ☐ ENGINEERING SOFTWARE ☐ ONE OWS ☐ ALL OWS ☐ LAPTOP		OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification. One number Laptop is mandatory.	
SAFETY STANDARD	☐ SIL-3 ☐ SIL-2 ☒ NIL			
	COMPUTER FURNITURE	BOQ ☒ YES ☐ NO INDUSTRIAL GRADE ☒ YES ☐ NO		
SPARE LIST	SPARE LIST	☐ START UP & COMMISSIONING ☒ MANDATORY SPARE ☐ RECOMMENDED		
	SPARE LIST ATTACHED	☒ YES ☐ NO		
REDUNDANCY	CPU	☒ YES ☐ NO		
	POWER SUPPLY	☒ YES ☐ NO		
	COMMUNICATION	☒ YES ☐ NO		
	I/O CARD	☐ YES ☐ NO		
	OTHER ELECTRONICS	☐ YES ☐ NO		As per vendor practice

	DATA SHEET FOR PLC SYSTEM		SPECIFICATION NO.: PE-TS-410-	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 18.03.2015
			SHEET 1	OF 1
Data Sheet No.:				
Data Sheet A&B				
DATA SHEET – A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)			DATA SHEET – B FOR PLC SYSTEM (TO BE FILLED BY BIDDER)	
No. of CHANNELS PER CARD	ANALOG INPUT	■ 8 NOs □ 16 NOs		
	ANALOG OUTPUT	■ 8 NOs □ 16 NOs		
	BINARY INPUT	■ 16 NOs □ 32 NOs		
	BINARY OUTPUT	■ 16 NOs □ 32 NOs		
	RTD**	4 NOs		
	THERMOCOUPLE**	8 NOs		
	ELECTRONIC CARD ISOLATION	□ GALVANIC □ OPTICAL □ OTHER		
PANEL	QUANTITY	BIDDER TO INDICATE		
	CLASS OF PROTECTION(Refer Location of PLC)	■ IP-42		
	REMOTE I/O PANEL	■ YES □ NO AC REQUIREMENT ■ YES □ NO		
	COLOUR#	RAL 7032		
	BACK-UP DESK	□ YES ■ NO		
	MIMIC	□ YES ■ NO IF YES, THEN □ PANEL MOUNTED GUI □ ACRYLIC		
	CONTROL HARDWARE	□ PB □ INDICATORS ■ FACIAS 25 Nos. □ OTHERS		
	CONFORMAL COATING	□ YES ■ NO		
COMMUNICATION WITH OTHER SYSTEM	HARDWIRED	■ YES □ NO		
	PURPOSE	□ CONTROL ■ MONITORING		
	MEDIUM	□ UTP ■ FIBRE OPTIC □ OTHERS		
	TIME SYNCHRONIZATION SIGNAL FORMAT	□ PULSE □ RS-485 ■ IRIG-B □ NTP		
	SOFTLINK	□ MODBUS ■ OPC IF MODBUS THEN □ RS-485 □ ETHERNET		
	SERIAL LINK	COMMUNICATION PORT TYPE _____		
POWER SUPPLY INPUT FEEDER	PLC PANEL	BIDDER TO INDICATE LOAD DATA		
	REMOTE I/O PANEL	BIDDER TO INDICATE LOAD DATA		
POWER SUPPLY	SOURCE \$\$	■ UPS (INDUSTRIAL GRADE) □ 24V DC CHARGER		
	BATTERY TYPE	□ Ni-Cd ■ LEAD ACID □ OTHERS		
	BACK-UP TIME	□ 30 MINS ■ 60 MINS □ OTHERS		
	BATTERY CONFIGURATION	□ 1X100% ■ 2X100% □ 2X50%		As per MAX philosophy
CUSTOMER TRAINING	TRAINING	■ REQUIRED □ NOT REQUIRED		
	NO OF DAYS	3 DAYS		
	LOCATION	□ VENDOR'S WORK □ PROJECT SITE □ OTHERS		

*IF THE LOCATION IS INDOOR, KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.

**SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.

PROJECT SPECIFIC PAINT SHADES, IF APPLICABLE TO BE USED.

\$\$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

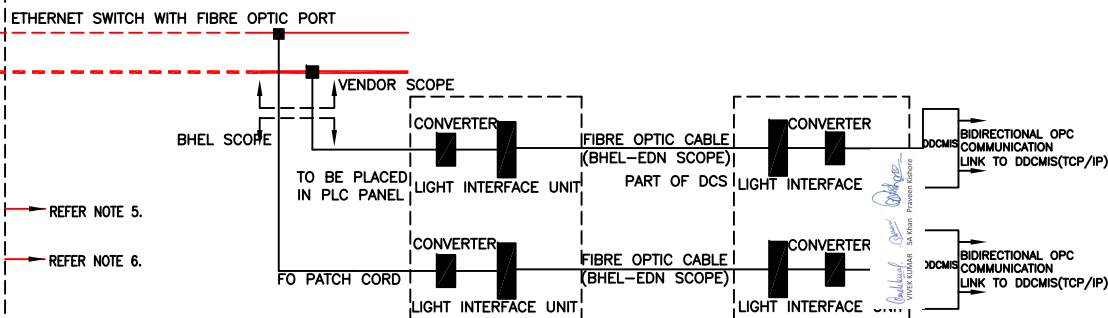
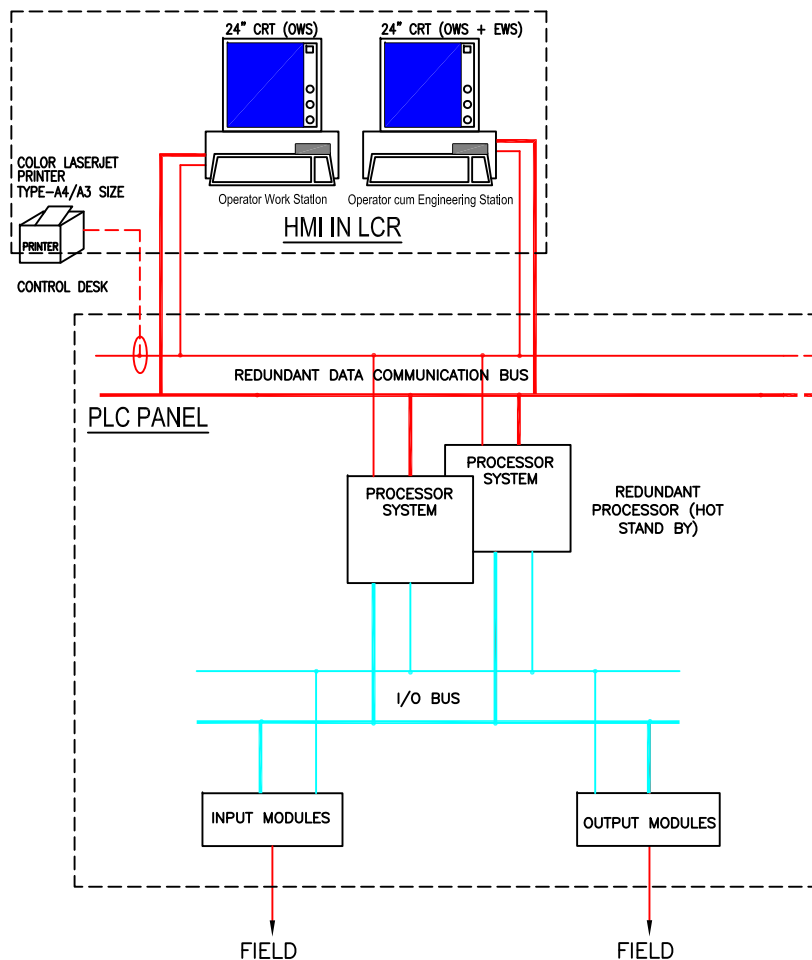
DATE : 18.03.2015

SHEET

OF

PLC CONFIGURATION

Praveen Kishore
SA Khan
Praveen Kishore
Vivek Kumar
VIVEK KUMAR



NOTES:

- 1) TABLE TOP OWS/EWS SHALL BE 24" OR AVAILABLE INDUSTRY STANDARD.
- 2) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR, POWER SUPPLY AND COMMUNICATION SYSTEM.
- 3) UPS POWER SUPPLY SHALL BE USED FOR PLC PANEL(S), OWS/EWS AND NETWORK COMPONENTS.
- 4) POWER SUPPLY ARRANGEMENT FOR PLC SYSTEM SHALL BE AS SHOWN ON SHEET 2 OF 2.
- 5) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (NTP/IRIG-B) FROM MASTER CLOCK SYSTEM (BHEL SUPPLY).
- 6) PLC PANEL SHALL HAVE PROVISION FOR DATA EXCHANGE (OPC) WITH PLANT DCS.
- 7) NECESSARY PATCH CORD/CONVERTERS, LIU AT BOTH PLC AND DCS END SHALL BE IN BHEL-EDN SCOPE.

LEGEND: -

- PLC - PROGRAMMABLE LOGIC CONTROLLER
- DCS - DISTRIBUTED CONTROL SYSTEM
- UPS - UNINTERRUPTED POWER SUPPLY
- OWS/EWS - OPERATOR WORK STATION/ ENGINEERING WORK STATION
- HMI - HUMAN MACHINE INTERFACE
- NTP - NETWORK TIME PROTOCOL
- OPC - OLE PROCESS CONTROL
- MCCB - MOULDED CASE CIRCUIT BREAKER
- MCB - MINIATURE CIRCUIT BREAKER
- LCR - LOCAL CONTROL ROOM
- CCR - COMMON CONTROL ROOM



PROJECT:

1X800 KOTHAGUDEM TPS
STAGE-VII, UNIT-12

DRG.NO.

PE-DM-410-145-I900

DATE

23.02.2015

TITLE:

PLC CONFIGURATION
AC/VENTILATION

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00

DATE : 18.03.2015

SHEET

OF

PLC Quality Plan

Praveen Kishore
SA Khan
Praveen Kishore
Vivek Kumar
VIVEK KUMAR

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									VOLUME IIB			
									SECTION D			
									REV. NO. 01 DATE: 24.08.2007			
									SHEET 1 OF 8			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
1.0	Materials /Components											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2		1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection • Identification Labels • Physical Damages • Quantity • Spare Capacity	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1	

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

\$

P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

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								SHEET 2		OF 8		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1	


 Project Engineer

 Quality Engineer

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

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								SECTION		D			
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								SHEET		3		OF	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks	
									P	W	V		

2.0	Assembly											
2.1	Functional Test for HMI/OVS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2	1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2	1	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2	1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100%	FAT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2	2	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	

3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

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FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, [to the inspecting agency](#), his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. [Check online replacement of cards, processors, power supply etc.](#)

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy


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ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

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6. Control Panel /Desk Verification

- i) PLC driven annunciation system should be checked by alarm signal simulation.
- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

- i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- ii). Engineering features:-
 - a) Online changing of parameters, set points.
 - b) Online modification in Control Logic Diagrams.
 - c) Online configuration of Graphics, Trends, Logs, HSR.
- iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.


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8. Burn in **Elevated Temperature** test

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

- a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

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ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.


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Technical specification for
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ACTUATOR SPECIFICATION

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SA Khan
Praveen Kishore
Vivek Kumar
VIVEK KUMAR

VOLUME: V-A

SECTION-III

TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS

1.00.00 **SCOPE**

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves/dampers.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. All the electrical actuators shall be INTEGRAL type only.

2.00.00 **STANDARDS**

2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed

i) IS -9334

ii) IS-325

3.00.00 **SERVICE CONDITIONS**

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.

3.03.00 For actuator motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 **RATING**

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

- 5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.
- 5.02.00 Attain full speed operation before valve load is encountered and imparts an unseating blow to start the valve in motion (hammer blow effect).
- 5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
- 5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
- 5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

- 6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring.
- 6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy. Degree of protection of enclosure for motor actuator shall be IP-65.
- 6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 **Motor**

- 6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.
- 6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.
- 6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.
- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be with integral starter with 3phase/3wire, 415V AC and operable from remote.

- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall de-energize automatically when the motor is energized.
- 6.05.00 **Position Indicator/Transmitter**
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, 4-20 mA current signal as position feedback, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. All wiring shall be done with 1100 V grade fire resistance PVC insulated stranded copper conductor of not less than 2.5 Sq.mm cross section. All wiring shall be identified at both ends with ferrules. All the electrical actuators shall have uniform wiring.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.
- 7.00.00 **ACCESSORIES**


V.V. A/S-III
SA Khan - Praveen Kishore

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V control transformer with primary & secondary fuses.

8.00.00 **TEST**

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 **DRAWINGS, DATA & MANUALS**

- 9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **To be submitted with Bid**

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues. Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, BOM, control & schematics, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A : Technical Specifications for Electrical Equipment & Accessories.


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ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

S	upply	Description	Consumer
	L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz Effectively earthed	u Motors above 0.2kW pto less than 175kW.
		Fault level 50 kA symm. for 1 sec.	
	(ii)	240V AC/415V AC	Motors upto 0.2kW.
		240V, 1Ø, 2W, 50 Hz effectively earthed	o Lighting, Space heat- ing , A.C supply for Contr- l & protective devices.
	D.C. Supply	220V, 2W, unearthed	& D.C. alarm, control protective devices
		Fault level 25* kA. for 1 sec.	

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

A.C. Supply :

V	oltage	:	± 10%
	Frequency	:	+3% to -5%.
	Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242


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Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: PE-TS-410-145-I		
VOLUME		
SECTION		
REV. NO.	00	DATE : 18.03.2015
SHEET	OF	

Actuator Data Sheet

Praveen Kishore
SA Khan
Praveen Kishore
Vivek Kumar
VIVEK KUMAR

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:		
			VOLUME		
			SECTION		
			REV. NO.	00	DATE: 06.01.2015
			SHEET	1	OF
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
GENERAL*	* PROJECT	1 X 800 MW KOTHAGUDAM TPS			
	OFFER REFERENCE				
	* TAG NO. SERVICE				
	* DUTY	☐ ON / OFF	☐ INCHING		
	* LINE SIZE (inlet/outlet): MATERIAL				
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY			
	* OPENING / CLOSING TIME				
	* WORKING PRESSURE				
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%			
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY			
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY			
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY			
	CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, DUST TIGHT, WEATHER PROOF, SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, IP:65		
MECHANICAL POSITION INDICATOR		TO BE PROVIDED FOR 0-100% TRAVEL			
BEARINGS		DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.			
GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION		METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.			
SIZING		OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 90% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR REGULATING SERVICE - 150 STARTS/HR MINIMUM			
HANDWHEEL	* REQUIRED	☒ YES ☐ NO			
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED			
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.				
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY			
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY			
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF I.S. TOLERANCE			
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED ☒ DRG. NO. 3-V-MISC-24227 R00 (INDICATIVE)			
	COLOUR SHADE	☒ BLUE (RAL 5012), To be decided during detail engg.			
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☒ EPOXY ☐			
	SHAFT RPM	BIDDER TO SPECIFY			
	OLR SET VALUE	BIDDER TO SPECIFY			
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY			
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY			
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC, 3 WIRE			
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V			
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 65 ☐ FLAME PROOF			

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 Praveen Kishore

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:		
			VOLUME		
			SECTION		
			REV. NO. 00	DATE: 06.01.2015	
			SHEET 2	OF 3	
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
INTEGRAL STARTER	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B			
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☐ _____			
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED			
	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED			
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS			
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)			
	IF SMART	NOT APPLICABLE			
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED			
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐			
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC			
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED			
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐			
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED			
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP			
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED			
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED			
	OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED			
	STOP PB	☒ REQUIRED ☐ NOT REQUIRED			
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED			
	LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED			
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED			
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT. /POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)			
	INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☒ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER		
		QUANTITY	☐ 2 Nos. ☒ 3 Nos.		
		DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC		
		DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX		
		LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms		
	TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
OPEN / CLOSE		☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos			
CONTACT TYPE		2 NO + 2 NC			
RATING		5A 240V AC AND 0.5A 220V DC			
CALIBRATED KNOBS(OPEN&CLOSE TS)		REQUIRED FOR SETTING DESIRED TORQUE			
ACCURACY		+3% OF SET VALUE			
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN : INT : CLOSE	☐ 1 No. ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.	
	CONTACT TYPE	2 NO + 2 NC			
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC			

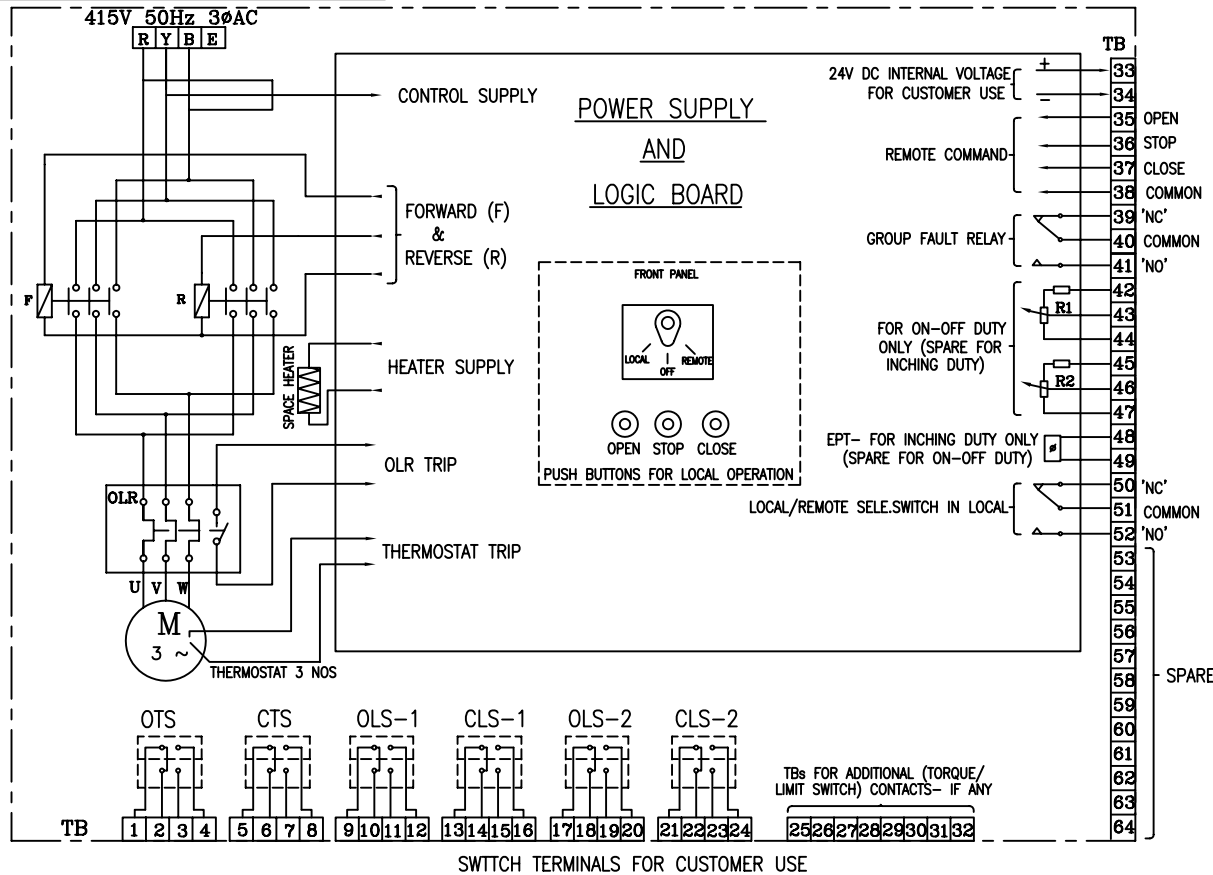
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 SA Khan Praveen Kishore

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:		
			VOLUME		
			SECTION		
			REV. NO.	00	DATE: 06.01.2015
			SHEET	3	OF 3
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
POSITION TRANSMITTER	POSITION TRANSMITTER	☒ REQUIRED ☐ NOT REQUIRED			
	MFR & MODEL NO.	BIDDER TO SPECIFY			
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☒ ELECTRONIC (2 WIRE) CONTACTLESS			
	SUPPLY	☒ 24V DC ☐			
	OUTPUT	☒ 4-20mA			
	ACCURACY	± 1% FS			
SPACE HEATER	@SPACE HEATER	REQUIRED			
	@ POWER SUPPLY (NON INTEGRAL)	240V AC, 1 PH., 50 Hz			
	@ POWER SUPPLY (INTEGRAL)	240V AC, 1 PH/415/240 V CTRL TRANSFORMER WITH PRIMARY AND SECONDARY FUSES			
	@ RATING				
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED			
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☐ IP 68 @ ☐			
	@ EARTHING TERMINAL	REQUIRED			
	PLUG & SOCKET (9 PIN) (FOR COMM, LS/TS FEED BACK, PoT)	☐ REQUIRED ☒ NOT REQUIRED ☐ 2 NOS. ☐			
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:			
	@ SPACE HEATER CABLE GLAND	SIZE:			
	OTHER CONTROL CABLE GLANDS-1	INSTRUMENT CABLE SIZE FOR ON/OFF DUTY VALVES SHALL BE 8PX0.5 SQMM - ONE CABLE GLAND OF OD SIZE 20 MM.			
	OTHER CONTROL CABLE GLANDS-2	INSTRUMENT CABLE SIZE FOR INCHING DUTY TYPE VALVES SHALL HAVE TWO NO. CABLES (ONE NO. 8PX0.5 SQMM AND 2ND 2PX0.5 SQMM) - TWO NO. GLANDS OF OD SIZES 20 MM & 15 MM.			
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.	
NOTES: SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 - TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C. - CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL, WITH NICKEL COATING SHALL BE PROVIDED. - THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE. - THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. - THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING. \$\$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE. ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.					
			VENDOR COMPANY SEAL NAME SIGNATURE DATE		
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY), @ = TO BE FILLED BY ES					

WVEK KUMAR SA Khan Praveen Kishore
 06/01/2015

3-V-MISC-24227

DRAWING NO.



CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL				
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL				
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL				
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL				
OLS-1	9-10					
	11-12					
CLS-1	13-14					
	15-16					
OLS-2	17-18					
	19-20					
CLS-2	21-22					
	23-24					
SWITCH	TERMINAL NO.	FULL OPEN	a	INTERMEDIATE	b	FULL CLOSE
		VALVE POSITION				
 INDICATES CONTACT CLOSED						
 INDICATES CONTACT OPEN						
CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC						

SETTING PROCEDURE OF

ION LIMIT AND TORQUE SWITCH

VALVES

OPEN

CLOSE

MAIN

BACK UP

MAIN

BACK UP

GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS

OLS

OTS *

CLS

CTS

ALL OTHER GATE & GLOBE VALVES

OLS

OTS *

CTS

#

- CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

NOTE:-

- ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE.
ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
- CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
- OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
- OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
- CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
- EPT - ELECTRONIC POSITION TRANSMITTER (Contactless, FOR INCHING DUTY)
- R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
- FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
- M - MOTOR 3Φ 415V 50 Hz AC SUPPLY

REV	DATE	ALTERED
		CHD & APPD

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TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT		ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)						
 365-121	BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT. TIRUCHIRAPALLI-620014.		DRN	NAME N.P.ESWAR	SIGN N.P.	DATE 07.10.04	NO.OF VAR.	
	DEPT VL	SCALE	WEIGHT (KG).	CHD	D.DINAKARAN	D.D	07.10.04	
	CODE			APPD	K.ARUNACHALAM	K.A	07.10.04	
TITLE WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER		CARD CODE U 01	REFERENCE INFORMATION DRAWING NO. 3-V-MISC-24227 Page 271 of 513				REV 0	
Page no. 40 of 131								



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

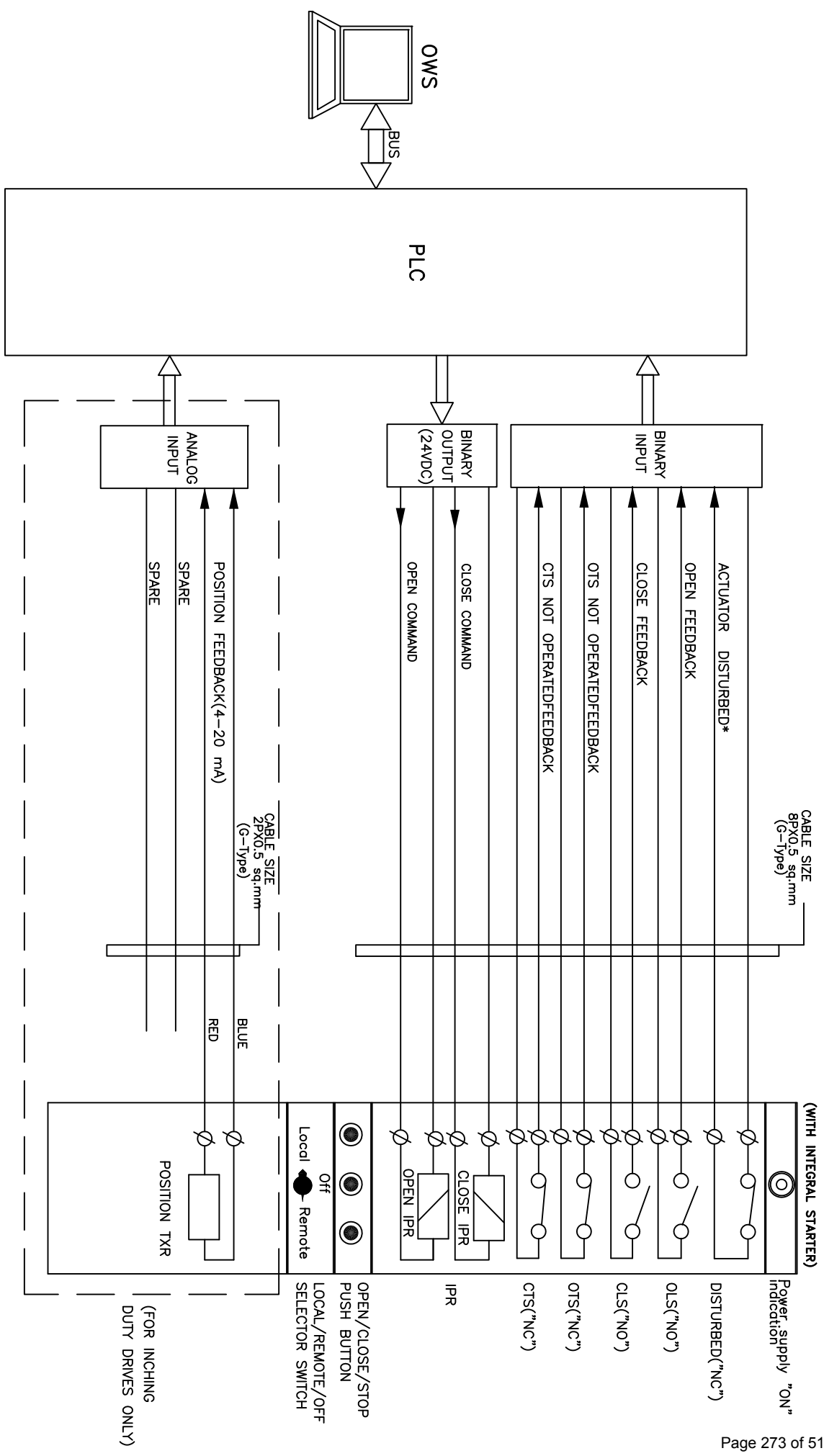
DATE : 18.03.2015

SHEET

OF

Drive Control Philosophy

Praveen Kishore
SA Khan
VIVEK KUMAR



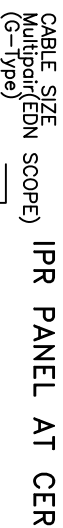
NOTE:

* DISTURBED=

Loss of Power supply (1 Phase/3 Phase)/
Loss of control supply/ Motor thermostat trip/
Thermal over load/Torque over/ Motor stall mode/
Local/Off/Remote Sel. switch
Stop PB optd.

PROJECT: 1X800 KOTHAGUDEM TPS		DRG.NO.	PE-DM-410-145-1002
STAGE-VII, UNIT-12		DATE	12.03.2015
TITLE: PLC INTERFACE FOR		REV.NO.	00
BIDIRECTIONAL DRIVE		SHT	7 OF 11





CONTROL CABLE
5CX2.5 sq. mm

MCC

- CABLE (PEM-ELEC)

BUS

PLC

BINARY
INPUT

MCC DISTBD (THERMAL O/L OPTD/CONT SUPP
FAIL/EPB OPTD/MCC ISOLATED/SS NOT IN REMOTE)
COMMON

LOCAL START

CABLE SIZE
— 4PX0.5 sq mm
(G-Type)

— CABLE (PEM-ELEC)

CURRENT FEEDBACK(FOR DRIVES $\geq 30\text{KW}$ & CRITICAL DRIVES $<30\text{KW}$)(4-20mA)

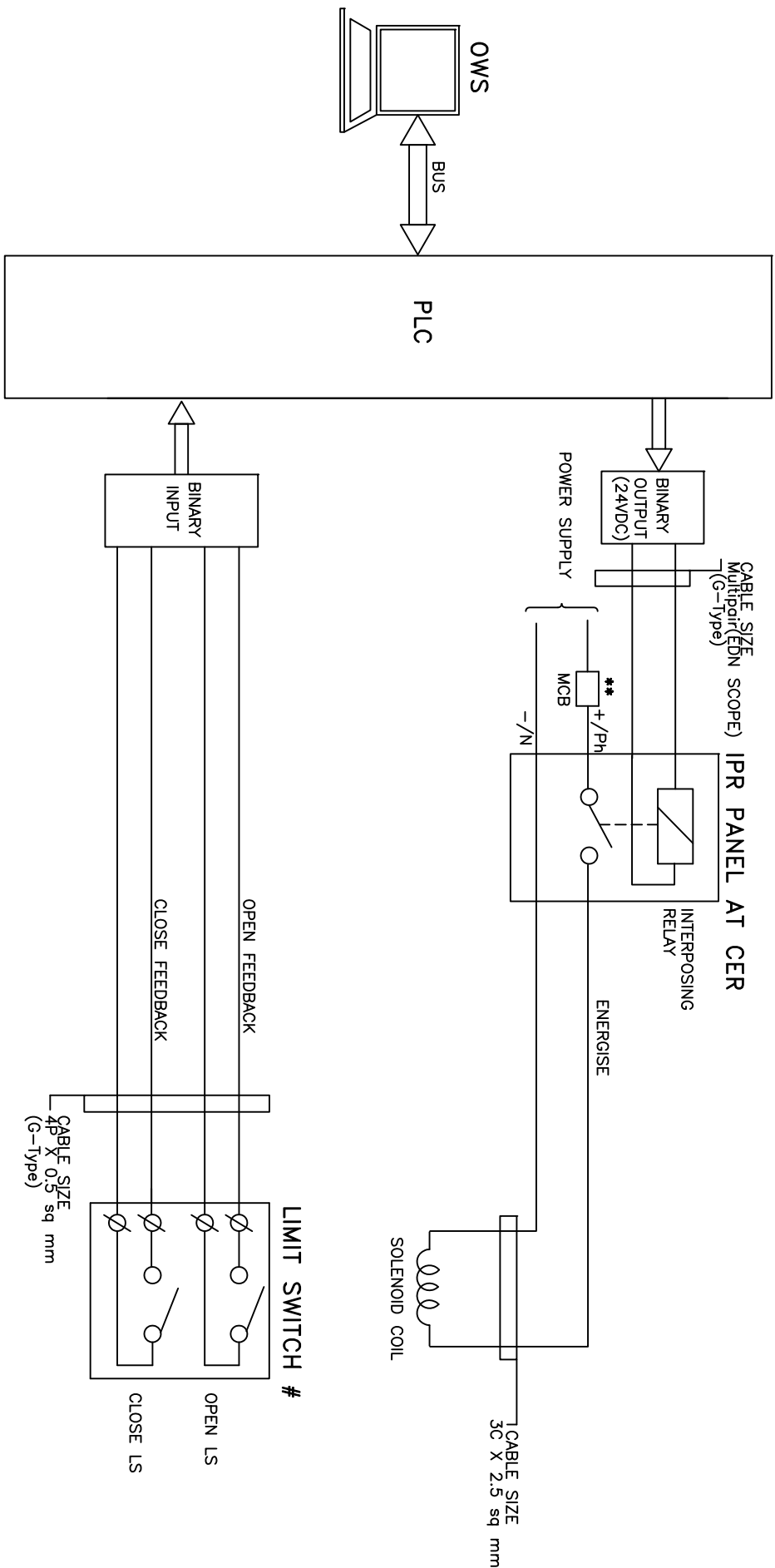
☐ CABLE SIZE
2PX0.5 sq mm
(G-Type)

CURRENT
TRANSDUCER

* FOR LTUD DRIVES ALL LUBE OIL PUMPS, SCANNER AIR FANS, SEAL AIR FANS, 4-20MA CURRENT TRANSDUCER SHALL BE CONSIDERED.

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PLC INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)



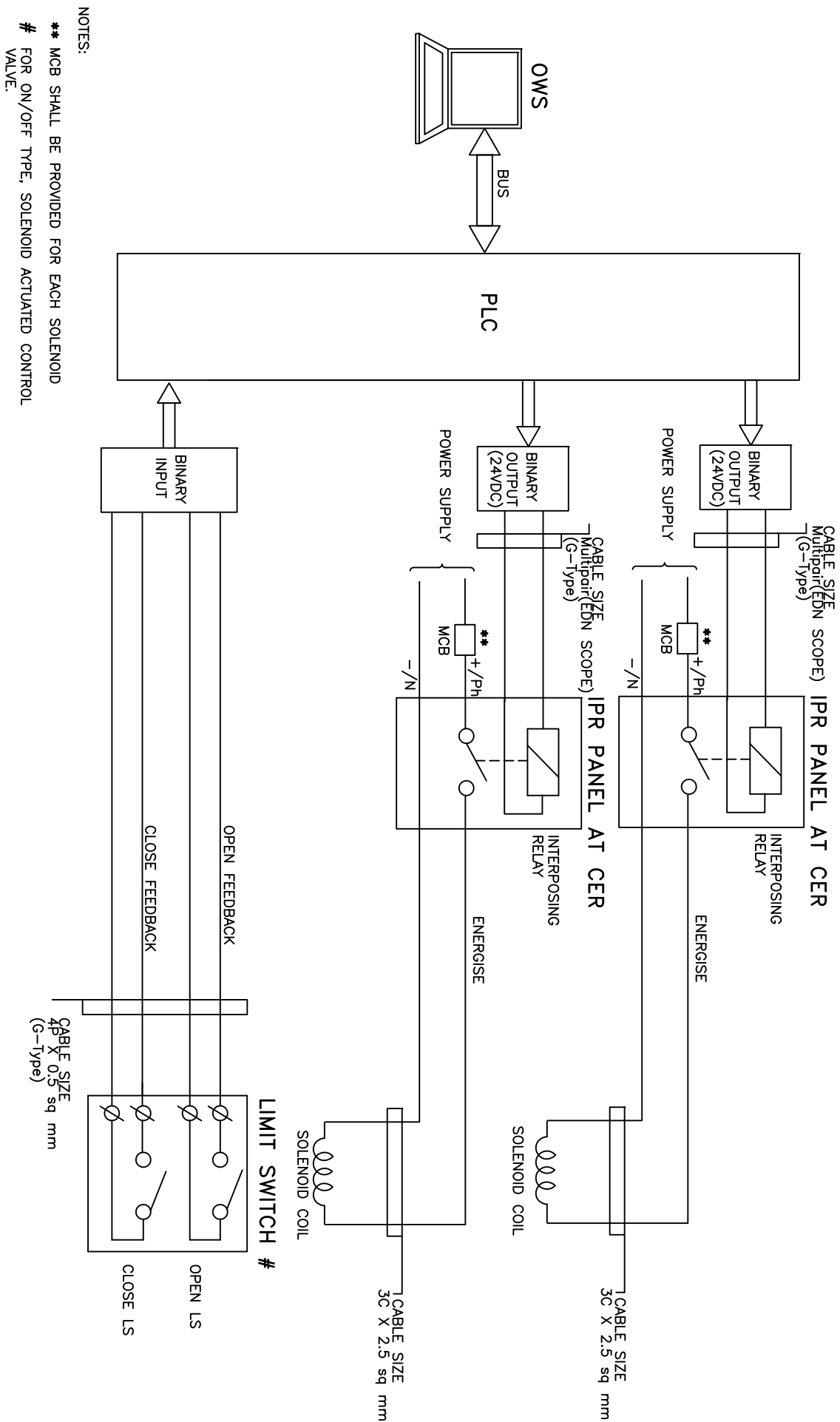
NOTES:

- ** MCB SHALL BE PROVIDED FOR EACH SOLENOID
- # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

PROJECT:		1X800 KOTHAGUDEM TPS		DRG.NO.	PE-DM-410-145-1002
TITLE:		STAGE-VII, UNIT-12		DATE	12.03.2015
		PLC INTERFACE FOR		REV.NO.	00
		SOLENOID DRIVE (SINGLE COIL)		SHT	9 OF 11



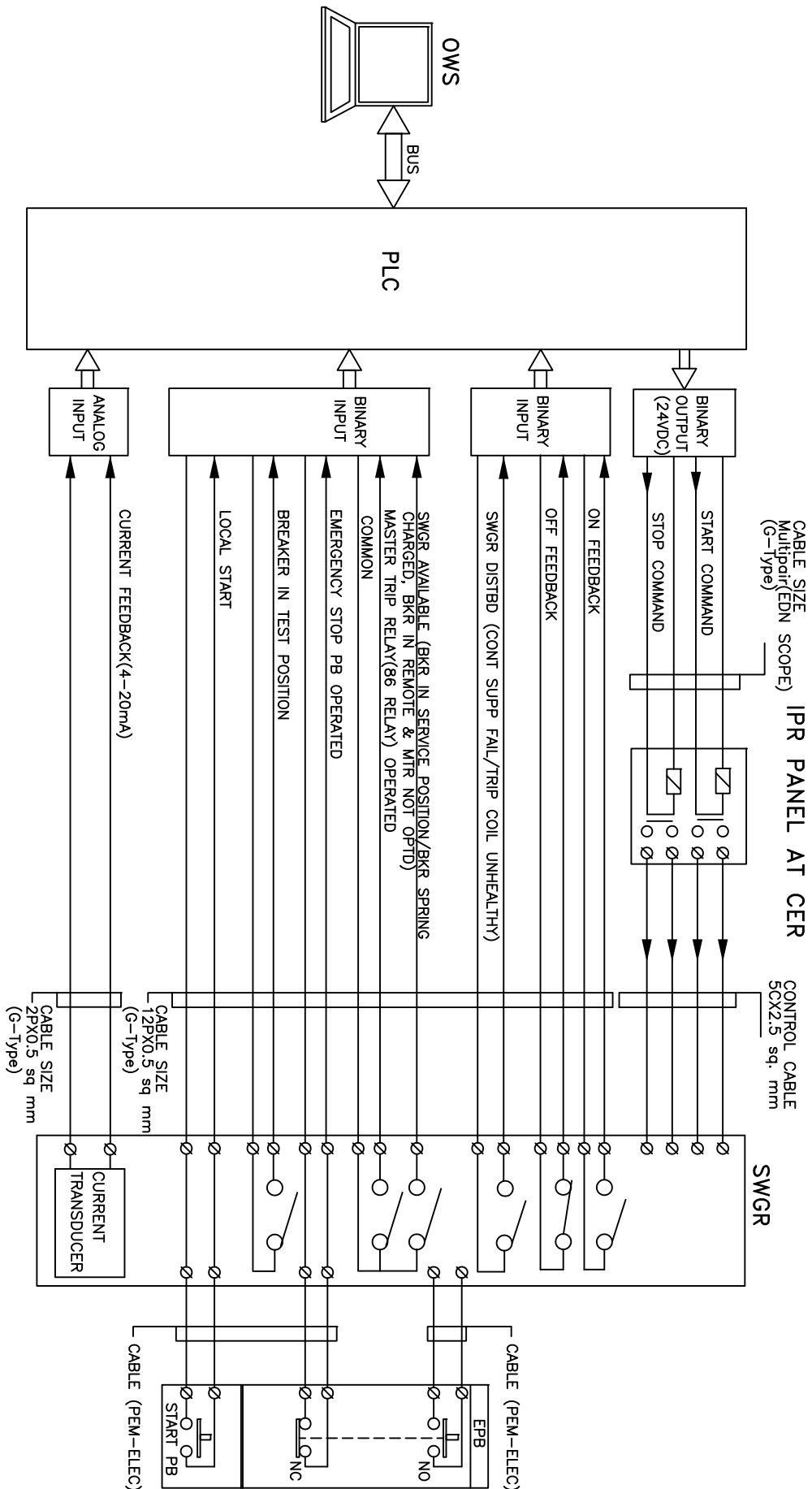
PLC INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)



PROJECT:		1X800 KOTHAGUDEM TPS		DRG.NO.	PE-DM-410-145-1002
TITLE:		STAGE-VII, UNIT-12		DATE	12.03.2015
		PLC INTERFACE FOR		REV.NO.	00
		SOLENOID DRIVE (DOUBLE COIL)		SHT	9d OF 11



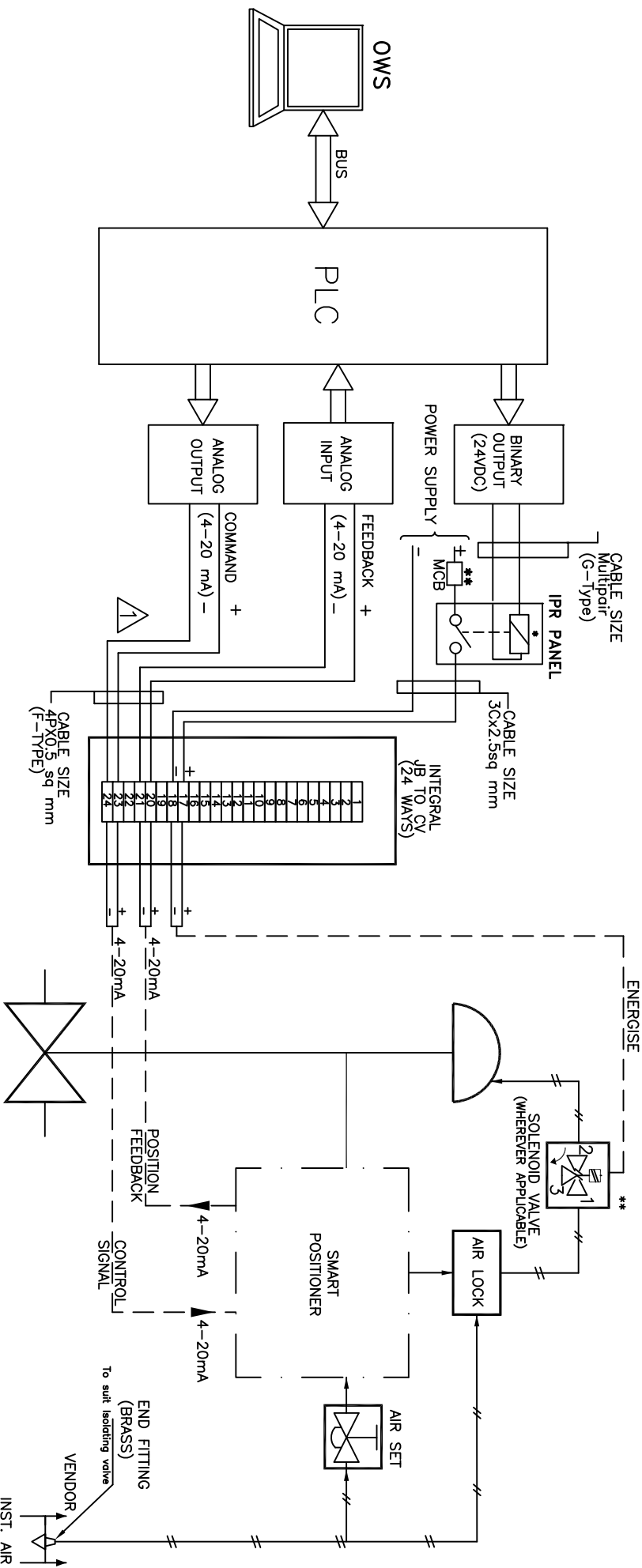
PLC INTERFACE FOR HI/LI UNIDIRECTIONAL DRIVES(BREAKER OPERATED)



PROJECT:		1X800 KOTHAGUDEM TPS		DRG.NO. PE-DM-410-145-1002	
TITLE:		STAGE-VII, UNIT-12		DATE 12.03.2015	
PLC INTERFACE FOR		UNIDIRECTIONAL HT DRIVE		REV.NO. 00	
SHT		10 OF 11		11	



PLC INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

**** APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.**

 Mitsubishi Electric Mitsubishi Company	PROJECT:		1X800 KOTHAGUDDEM TPS STAGE-VII, UNIT-12	
	TITLE:		TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	
	DRG. NO.	PE-DW-410-145-1002		
	DATE	12.03.2015		
	REV. NO.	00		
	SHT	11	OF	11



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

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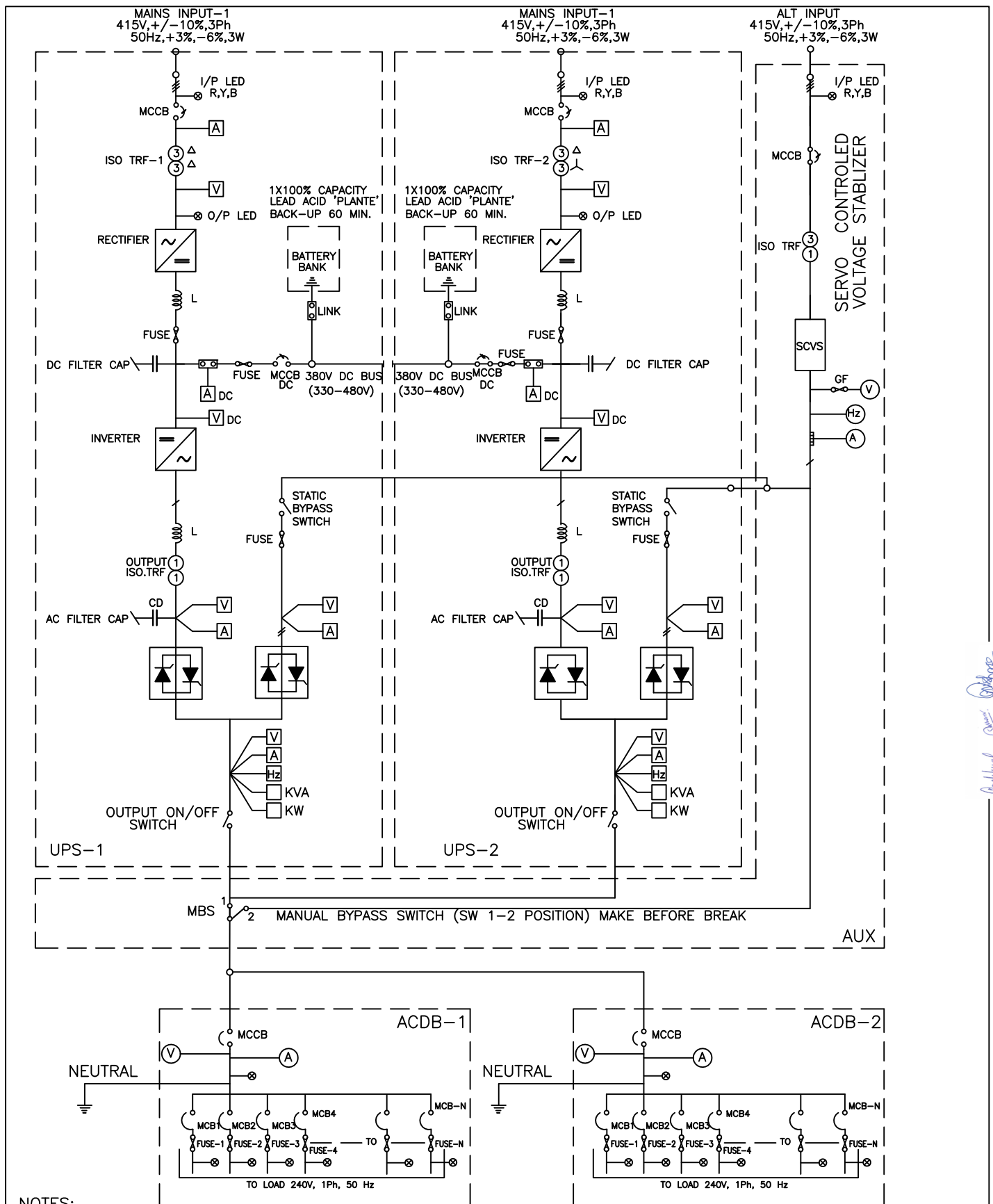
DATE : 18.03.2015

SHEET

OF

UPS SCHEME

Praveen Kishore
SA Khan
Praveen Kishore
Vivek Kumar
VIVEK KUMAR



WIREK KUMAR SA Khan Praveen Kishore



1 X 800 MW KOTHAGUDEM TPS

TITLE:-

UPS SINGLE LINE DIAGRAM

DRG.
No.

PE-DG-410-145-I004

REV.
No.

00

DATE

04.02.2015

SHEET

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Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: PE-TS-410-145-I		
VOLUME		
SECTION		
REV. NO.	00	DATE : 18.03.2015
SHEET	OF	

INSTRUMENTATION DATA SHEET

Praveen Kishore
SA Khan
Praveen Kishore
Vivek Kumar
VIVEK KUMAR

1.00.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS

1.01.00 PRESSURE TRANSMITTER

1. Working Principle : Smart (HART Compatible)
2. Type : Microprocessor based, 2 – Wire
3. Output Signal : 4-20 mA DC along with superimposed digital signal
4. Measuring Element : Capsule / Diaphragm
5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10. Output Indicator : LCD (Integral indicator of 5 digit display)
11. Nameplate : Tag number, service engraved in SS tag plate
12. Body : SS
13. Operating Voltage : 24V DC
14. Load : 600 Ohms (min.) at 24 Volts D.C.
15. Ambient Temperature : 0 - 50 °C
16. Performance: :
 - i. Accuracy : $\pm 0.075\%$ of Span or better

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- ii. Repeatability : $\pm 0.05\%$ of Span or better
17. Sealing/Isolation : Extended diaphragm (Silicon oil/Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18. Accessories :
- a. Universal mounting bracket suitable for 2" pipe mounting
 - b. High tensile carbon steel U-bolts
 - c. Siphon for steam and hot water services
 - d. 1/2" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock
 - e. Companion flange with nuts, bolts and gaskets
 - f. 1/2" NPT cable gland
 - g. Handheld calibrator
19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

Notes: For primary air/ secondary air/ flue gas applications, DP type transmitters shall be provided for pressure measurement.
LVDT type is not acceptable.

1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER

- 1. Working Principle : Smart (HART Compatible)
- 2. Type : Microprocessor based, 2 – Wire
- 3. Output Signal : 4-20 mA DC along with superimposed digital signal
- 4. Measuring Element : Capsule / Diaphragm

5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10. Output Indicator : LCD (Integral indicator of 5 digit display)
11. Nameplate : Tag number, service engraved in SS tag plate
12. Body : SS
13. Operating Voltage : 24V DC
14. Load : 600 Ohms (min.) at 24 Volts D.C.
15. Ambient Temperature : 0 - 50 °C
16. Performance:
 - i. Accuracy : $\pm 0.075\%$ of Span or better
 - ii. Repeatability : $\pm 0.05\%$ of Span or better
17. Sealing/Isolation : Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18. Accessories :
 - a. Universal mounting bracket suitable for 2" pipe mounting
 - b. High tensile carbon steel U-bolts

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- c. Siphon for steam and hot water services
- d. ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock
- e. Companion flange with nuts, bolts and gaskets
- f. ½" NPT cable gland
- g. Handheld calibrator

19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

1.03.00 Displacer Type Level Transmitters

- 1. Type : Smart (HART Compatible)
- 2. Stages of operation : Continuous
- 3. Material :
- 4. i. Displacer SS-316
- 5. ii. Suspension wire SS-316
- 6. iii. Torque tube housing SS
- 7. iv. Torque tube Inconel
- 8. v. Displacer chamber SS
- 9. vi. Transmitter Housing SS
- 10. Operating Voltage : 24 V DC
- 11. Transmission : Microprocessor based, 2-wire
- 12. Output Signal : 4-20 mA DC along with superimposed digital signal
- 13. Static / overload : Maximum static pressure without


 VIVEK KUMAR, SA Khan, Praveen Kishore

	pressure	permanent deformation or loss of accuracy
14.	Turn-down ratio	: 10 : 1 or better
15.	Zero & Span	: Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
16.	Enclosure Class	: IP-65
17.	Output Indicator	: LCD type (Integral indicator of 5 digit display)
18.	Nameplate	: Tag number and Service engraved in stainless steel tag plate
19.	Ambient Temperature	: 0 - 50 °C
20.	Load Impedance	: 600 Ohms at 24 Volts (minimum)
21.	Process Connection	: 2" Flanged
22.	Performance - Accuracy	: ± 0.075 % of span or better
23.	Accessories	: a) Counter Flange, nuts, bolts, gaskets etc b) Weights for 5 point calibration of instruments c) Vent and drain plugs d) $\frac{1}{2}$" NPT Glands e) Handheld calibrator
24.	Preferred Features	: a) Test plug connection and cutout terminals physically separated from other electronics b) Electronic Damping facility (adjustable)
25.	Adjustment/Calibration/ Maintenance	: From handheld calibrator/ HART management system


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	26. Applications	: During detail engineering on Owner's approval
1.04.00	MASS FLOW METER	
1.04.01	SENSOR	
	1. Measuring Principle	: Coriolis Mass flow
	2. Primary Element	: Flow Tube of 316SS or better
	3. Heating Arrangement	: Integral
	4. Temperature Control	: For heavy fuel oil application
	5. Process Connection	: Flanged of rating as per process requirement
	6. Drain	: Self-draining facility
	7. Enclosure	: Stainless steel
	8. Accessories	: Counter flanges, Mounting nuts, bolts, gaskets etc.
1.04.02	TRANSMITTER	
	1. Measured quantities	: Mass Flow rate, Total Mass Flow, Density
	2. Input Signal Processing	: Smart (HART compatible)
	3. Display	: LCD
	4. Output	: 2 nos. isolated output of 4-20mA DC selectable from four measured quantities
	5. Load	: < 750 ohms
	6. Power supply	: 240V AC, 50 Hz


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7. Turn Down : 100:1
8. Accuracy : ± 0.2 % of measured value
9. Housing : IP 65 (Explosion proof)
10. Nameplate : Tag number, service engraved in stainless steel tag plate
11. Accessories :
 - a) Handheld calibrator
 - b) Mounting U-bolts, nuts, bolts, prefab cable etc
 - c) $\frac{1}{2}$ "NPT cable gland
12. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system
13. Applications : Fuel Oil service

1.05.00 RADAR TYPE LEVEL MEASUREMENT

1. Type : Smart (HART Compatible)
2. Antenna : Co axial / guided wave radar / Overspill protection
3. Principle : TDR (Time Domain Reflectometry)
4. Communication : Two wire 4-20mA DC with HART
5. Environmental temperature : 0 – 50 °C
6. Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
7. Calibration :
 - a) Self calibration with internal reference
 - b) Zero & Span calibration
8. Process Connection : External cage mounting
Flanged /screwed
9. Electronic Housing : Epoxy painted Die-Cast aluminium

	alloy	
10. Antenna / Flange assembly	:	316 SS or Hest alloy (as required)
11. Power supply	:	24 V DC
12. Output Indicator	:	LCD
13. Accuracy	:	5 mm or 0.1% of probe length
14. Accessories	:	a) Handheld calibrator
	:	b) Counter Flange, nuts, bolts, gaskets etc
	:	c) ½"NPT cable gland
	:	d) SS Nameplate
15. Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system
16. Applications	:	Vessels under vacuum or low pressure applications, solid levels

1.06.00 ULTRASONIC LEVEL TRANSMITTER

1. Type	:	Microprocessor based, 2-wire, Smart (HART Compatible)
2. Operating Principle	:	Detection of reflected ultrasonic pulse
3. Output Signal	:	4-20 mA DC along with superimposed digital signal
4. Operating frequency	:	10 KHz to 50 KHz (typical)
5. Display	:	LCD
6. Temperature Compensation	:	Built in –Programmable
7. Power supply	:	24 V DC
8. Enclosure	:	SS, IP-65 (Explosion proof for NEC Class-1, Division 1 area)

9. Zero & Span : Continuous, tamper proof, remote as well locally adjustable. It shall be possible to calibrate the instrument without any level in the sump/ tank
10. Accuracy & Repeatability : 0.15 % of span or better
11. Resolution : 0.1 % of span
12. Operating temp. : Transmitter- 500 C and Sensor - 800 C
13. MOC Sensor : SS-316/Body- PVC and Face – Polyurethane
14. Mounting : 4" Flanged/ 2" NPT for sensor and Transmitter on panel
15. Accessories :
- a) Handheld calibrator
 - b) Weather canopy for protection from direct sunlight and direct rain
 - c) ½"NPT cable gland
 - d) All mounting hardware (SS-316), Prefab cable
 - e) SS Nameplate
16. Diagnosis : On-line
17. Status Indication : Power On, HI, HI-HI, Lo, LO-LO, Fault
18. Output Contacts : 2 SPDT, 230V, 5A
19. Adjustment/Calibration/ /Maintenance : From handheld calibrator/ HART management system
20. Applications : Coal Bunker, Water Service etc.


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1.07.00 ULTRASONIC FLOW TRANSMITTER

1. Type : Ultrasonic – Clamp On
2. Accuracy : +/- 1 % of reading
3. Repeatability : +/- 0.3 % of reading
4. Rangeability : 400 : 1
5. Output Signal : 4-20 mA DC with HART
6. Measured Parameter : Volumetric flow, Totalized flow and flow Velocity
7. Display : LCD with internal Key Pad (Flow rate & Totalization)
8. Power Supply : 24 V DC (2 Wire)
9. Enclosure : SS (IP- 68 – Submersible)
10. Mounting : SS Chain or Strap
11. Accessories
 1. Handheld calibrator
 2. ½"NPT cable gland
 3. Transducer cable
 4. All mounting hardware (SS-316)
 5. SS Nameplate
12. Adjustment/Calibration/ /Maintenance : From handheld calibrator/ HART management system
13. Applications : Plant water service

Note: Multi-path insertion type (minimum 4 path) Ultrasonic Flow meter shall be provided for Raw water/ Cooling Water flow measurements.

2.00.00 HART HAND HELD CALIBRATOR

Hand held calibrators (5 nos. for each type) shall be provided for adjustment/ calibration/maintenance of the HART compatible

transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.

3.00.00 **PROCESS ACTUATED SWITCHES**

3.01.00 PRESSURE SWITCH

1. Type :
 - i. Piston for high pressure application
 - ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS_t
4. Setter Scale : Black graduation on white linear scale.
Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure
6. Adjustments :
 - a) Internal Set Point
 - b) Differential adjustment
7. End Connection : 1/2" NPT bottom connected
8. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
9. Switch Type : Snap acting, shock & vibration proof
10. Terminal Block : Suitable for full ring lugs
11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12. Performance :
 - a) Repeat accuracy $\pm 1.0\%$
 - b) Accuracy of Setting Indication of $\pm 1.5\%$
13. Ambient temperature : 0 – 50 Deg.C

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14. Nameplate : Tag number, service engraved in SS tag plate
15. Accessories :
 - a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary for corrosive/ viscous/ solid bearing or slurry type fluid applications
 - b) Snubbers for pulsating fluid applications
 - c) Siphons for steam and hot water services
 - d) Retention ring and screws for surface mounting
 - e) 1/2" NPT 2 Valve SS-316 barstock manifold
 - f) 1/2" NPT cable gland
16. Applications : During Detail Engineering on Owner's approval

3.02.00 DIFFERENTIAL PRESSURE SWITCH

1. Type :
 - i. Piston for high pressure application
 - ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS
4. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure

6. Adjustments	:	a) Internal Set Point
	:	b) Differential adjustment
7. End Connection	:	1/2" NPT bottom/ back connected
8. Switch configuration	:	Two SPDT (240V, 5A AC/220V, 0.5A DC)
9. Switch Type	:	Snap acting, shock & vibration proof
10. Terminal Block	:	Suitable for full ring lugs
11. Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12. Performance	:	a) Repeat accuracy $\pm 1.0\%$
		b) Accuracy of Setting Indication of $\pm 1.5\%$
13. Ambient temperature	:	0 – 50 Deg.C
14. Nameplate	:	Tag number, service engraved in SS tag plate
15. Accessories	:	a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary Diaphragm seals for corrosive/ viscous/ solid bearing or slurry type fluid applications
		b) Snubbers for pulsating fluid applications
		c) Siphons for steam and hot water services
		d) Retention ring and screws for surface mounting
		e) 1/2" NPT 5 Valve SS-316 barstock manifold
		f) 1/2" NPT cable gland
16. Applications	:	During Detail Engineering on Owner's


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3.03.00 LEVEL SWITCH

3.03.01 FLOAT OPERATED

1. Float material : SS-316
2. Wetted parts : SS-316
3. Float chamber : Stainless steel/Carbon steel,
construction welded
4. Float chamber : Side mounted
mounting
5. Fluid connection : Side – Side
6. Fluid connection size : 1" ANSI RF Flange (rubber line, if
required)
7. Drain : ½ inch NPT with Plug
8. Pressure rating of
chamber : Minimum 1.5 times of design pressure
9. Repeatability : +/- 1.5 mm or better
10. Switch housing : Stainless Steel
11. Switch housing type : IP- 65
12. Type of switch : Snap acting magnetically operated
hermetically sealed
13. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
14. Accessories :
 - a) Counter flange, nuts
& bolts, suitable
gasket etc.
 - b) Steel globe type
drain valve
 - c) ½"NPT cable gland


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d) Stainless steel nameplate with alpha-numeric engraved for service and tag

15. Application : During Detail Engineering on Owner's approval

3.04.00 FLOW SWITCH

1. Type : Paddle /Piston/Disk
2. Wetted part material : Stainless steel or Hastelloy for acidic application
3. End connection :
 - a) Threaded upto 1" line size with integral Tee
 - b) Flanged for line size > 1 ½"
4. Enclosure material : Stainless Steel
5. Enclosure class : IP 65
6. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
7. Repeatability : 2%
8. Cable connection : ½"NPTF
9. Accessories :
 - a) Tee, Counter flange, nuts & bolts, suitable gasket etc
 - b) ½"NPT cable gland
 - c) Stainless steel nameplate with alpha-numeric engraved for service and tag

3.05.00 RF LEVEL SWITCH

1. Type : RADIO FREQUENCY
Sensing probe
2. Material : SS-316
3. Mounting : Threaded
4. Application : 250°C (Max.)
Temperature
Electronic Controller
5. Input Supply Voltage : 240V AC $\pm$ 10%, 50 Hz.
6. Relay Output : 2 SPDT (240V AC, 5A)
7. Ambient Temperature : 50 °C
8. Enclosure Protection : IP-66
9. Enclosure Housing : SS
Normal Level
10. Local LED Indication : Power On
Alarm Level
Probe Healthy
11. Switching Repeatability : $\pm$ 0.5%
Co-axial cable for probe connection to controller
12. Accessories : SS Tag plate
 $\frac{1}{2}$ " NPT Cable Glands
13. Application : Solid level

3.06.00 CONDUCTIVITY TYPE LEVEL SWITCH

1. Type : Conductivity discrimination
2. Probe MOC : SS-316
3. Mounting : Flanged on external cage
4. Application : 250°C (Max.)
Temperature
5. Test Pressure : Two times rated pressure

6. Input Supply Voltage	:	240V AC $\pm$ 10%, 50 Hz. Four independent channel with
7. Input	:	selectable switching threshold for water conductivity
8. Relay Output	:	2 SPDT (240V AC, 5A)
9. Ambient Temperature	:	50 °C
10. Enclosure Protection	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
11. Enclosure Housing	:	SS HI,LO, HIGH-HIGH, LOW-LOW
12. Local LED Indication	:	Power Fault
13. Accessories	:	a) Interconnecting cable from probe to electronics b) Mounting accessories c) External cage d) Washer & Gasket e) ½" NPT Cable Glands f) SS Tag Plate
14. Application	:	During Detail Engineering on Owner's approval

3.07.00 TEMPERATURE SWITCH

1. Type	:	Bimetallic or gas filled
2. Sensing Element Material	:	SS-316
3. Bulb Material	:	SS-316
4. Capillary	:	Stainless Steel armored

5. Movement Material : Stainless Steel
6. Case material : Stainless Steel with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
- 7.. Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
8. Over range Protection : 120 %
9. Instrument connection : Bottom
10. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
11. Switch type : Snap acting, shock and vibration-proof
12. Adjustability : Internal Set point adjustable over span range
13. Compensation :
 - a) Capillary compensation with invar wire throughout the capillary length
 - b) Case compensation
14. Performance
 - a) Scale Accuracy : ± 1.0 % of full scale
 - b) Repeatability : < 0.5 % of full range
 - c) Response time : Less than 40 seconds with thermowell
15. Capillary length : 5 meters (minimum) for local mounting/15 meters for local panel mounting
16. Nameplate : Tag number, service engraved in stainless steel tag plate
17. Accessories : Mounting accessories, $\frac{1}{2}$ " NPT cable gland
18. Applications : During Detail Engineering on Owner's


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4.00.00 **LOCAL INSTRUMENTS**

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

1. Type : Bourdon/Bellows/Diaphragm
2. Sensing & Socket : SS-316
3. Movement Material : SS-316
4. Case Material : Stainless steel. IP-65 (Explosion proof for NEC Class-1, Division 1 area)
5. Dial Size : Generally 150 mm
6. Scale : Black lettering on white in 270 O arc.
7. Window : Shatterproof glass
8. Range Selection : Normal process pressure: 50~70 % of range
9. Over-range Protection : 125% of maximum range by internal stop. External stop at zero
For Zero adjustment (Micrometer screw external)
10. Adjustment : For Range adjustment (Micrometer screw internal).
11. Element Connection : Argon welding
12. Process Connection : 1/2" NPT (M) Bottom for local, back for panel mounting
13. Performance : Accuracy of ± 1.0 % of span or better
14. Operating ambient : 0 - 50 °C
15. Safety Feature : Blow out disc /diaphragm at the back
16. Accessories :
 - a) Snubbers for pulsating fluid application.discharge
 - b) Stainless steel Diaphragm seals

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		for corrosive/ viscous/ solid bearing or slurry type fluid applications
	c)	3-Way SS316 Gauge cock for pressure gauges
		5-valve SS316 manifold from
	d)	barstock for differential pressure gauge
	e)	Siphons for steam and hot water services
17. Nameplate	:	Tag number, service engraved in stainless steel tag plate
4.02.00	LEVEL INDICATOR (FLOAT & BOARD TYPE)	
1. Type	:	Float and Board
2. Float Material	:	SS-316
3. Float Cable	:	SS-316
4. Indicator Assembly	:	Epoxy painted Aluminium
5. Guide wire spring assembly	:	SS-316 (2 Nos.)
6. Guide Wire Anchor	:	SS-316
		Anodized Aluminium with engraved marking (Minimum graduation 10mm),
7. Scale Board	:	mounting brackets and suitable hardware required as per tank height
8. Elbow Assembly	:	Anodized Aluminium
9. Flanges	:	RF , ANSI 150 , SS (3 Nos.)
10. Accuracy	:	± 10 mm or better
11. Accessories	:	All mounting accessories including counter flange, nuts & bolts, suitable


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gasket etc. as applicable, SS Tag plate

4.03.00 GAUGE GLASS

1. Type : Reflex /Transparent
2. Material :
Glass : Toughened borosilicate resistant to thermal shock
Body Material : ~~Carbon Steel~~ Stainless Steel
Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
3. Integral cocks & valves/Fittings :
i. SS 316
Rubber lined corrosion resistant
4. :
ii. stainless steel (for DM/RO service)
5. Vessel Connection : ANSI Flanged SS316
6. Accessories :
i. Integral cocks
ii. Drain Valves
Companion Flanges, Bolts, nuts,
iii. gaskets, SS Tag plate
Illuminating lamps, Mica shield as
iv. required
v. Calibrated scale
7. Pressure rating : Twice the maximum working pressure
8. Temperature : 300 ° C
For larger lengths (greater than 1200mm), additional gauge glasses
9. Other details : shall be provided with minimum of 50 mm overlap.


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- 4.04.00 SLIGHT GLASS
1. Type : Flap-type.
 2. End connection : Screwed / Flanged
 3. Material
 - a) Body : SS- 304
 - b) Cover plate : SS- 304
 - c) Indicator : SS- 316
 4. Sight Glass : Toughened Borosilicate
 5. Gasket : Neoprene
 6. Bolts & Nuts : High tensile steel.
 7. Hydraulic Test Pressure : 1.5 times maximum working pressure
 8. Accessories : Companion Flanges, Bolts, nuts, gaskets as required, SS Tag plate.
- 4.05.00 ROTAMETER
1. Type : ON-LINE for line upto and including 50 mm NB.
: Borosilicate BY-PASS for line size above 50 NB
 2. Metering tube : Toughened Borosilicate
 3. Float : SS-316
 4. End fittings : SS-316
 5. Packing material : Teflon / PTFE
 6. Casing : Stainless Steel
 7. Gland Rings : Stainless Steel
/Followers/ Other wetted parts
 8. Orifice Plate : Stainless Steel (for bypass type)
 9. Operating Temperature : 0-50 Deg. c


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10. Test Pressure	:	200% of maximum operating pressure
11. Scale	:	250 mm nominal length
12. Graduation	:	Direct reading
13. Process Connection	:	Flanged (RF) to line size as per ANSI standards (150#)
14. Tapping	:	D & D/2
15. Accuracy	:	+/- 2% of full scale reading
16. Reproducibility	:	Within 0.5% of instantaneous reading
17. Accessories	:	SS Tag Plate, orifice plate

5.00.00 **TEMPERATURE ELEMENTS & ACCESSORIES**

5.01.00 RESISTANCE TEMPERATURE DETECTOR

1. Type	:	Platinum (Duplex), Ungrounded
2. Platinum (Duplex), Ungrounded	:	100 ohm at 0 °C
3. Base	:	Wound on ceramic (anti-inductive)
4. Wiring	:	3 Wire
5. Protecting Tube		
a) O.D.	:	6 mm
b) Material	:	SS-316, Seamless
c) Filling	:	Magnesium oxide (Purity above 99.4%).
6. Response time	:	a) 15 sec. (bare). b) 30 sec. (with thermowell)
7. Calibration	:	DIN 43760
8. Accuracy	:	± 0.5%
9. Head		
a) Type	:	IP-65 universal screwed type


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- b) Material : Stainless Steel
- c) Terminal blocks : Nickel plated Brass-screw type / silver plated
- d) Cable connection : ½" NPT gland and grommet
- e) Others : Terminal head cover with SS chain and suitable gasket.

Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

10. Accessories :
- a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Thermowell (As specified below)
11. Thermowell connection : ½" NPT (M) or 150 RF Flanged
12. Nameplate : Tag number, service engraved in stainless steel tag plate


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Note: The specifications for RTDs of winding/ bearing 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 Pt-100.

5.02.00 THERMOCOUPLES

1. Type :
 - a) 16 SWG wire of Chromel Alumel) (Type-K)
 - b) Duplex
 - c) Ungrounded
2. Protecting Tube
 - a) O.D. : 6 mm
 - b) Material : SS-316, Seamless
 - c) Filling : Magnesium oxide (Purity above 99.4%).
3. Response time :
 - a) < 20 seconds for measurement
 - b) < 10 seconds for control
4. Accuracy : $\pm 1.1^{\circ}\text{C}$ up to 300°C & 0.4% of measured temperature range above 300°C
5. Head
 - a) Type : IP-65 universal screwed type
 - b) Material : Stainless Steel
 - c) Terminal blocks : Nickel plated Brass-screw type / silver plated
 - d) Cable connection : $\frac{1}{2}$ " NPT gland and grommet
6.
 - e) Others : Terminal head cover with SS chain and suitable gasket.


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Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

7.	Accessories	:	a) Adjustable nipple-union-nipple [1/2" Sch 80 X 1/2" NPT] with thermowell connection b) Compression fittings/unions c) Flanges etc. (for flanged connections only) d) Thermowell (As specified below)
8.	Thermowell connection	:	1/2" NPT (M) or 150 RF Flanged
9.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

5.03.00 TEMPERATURE GAUGE

1.	Type	:	Expansion type (Liquid filled system)
2.	Sensing Element Material	:	Bourdon – SS-316
3.	Bulb and Capillary Material	:	SS-316
4.	Capillary Tubing	:	Inner sheath - solid drawn Material copper tube Outer sheath - PVC tube
5.	Movement Materials	:	Stainless Steel / Direct Bourdon tip connection to pointer spindle
6.	Case Material	:	Stainless Steel stove enameled, black finish, threaded bezel ring, clear glass

		cover conforming to IP 65.
7.	Dial size	: 150 mm
8.	Scale	: Black lettering on white background in 270 Deg.C arc
9.	Over range protection	: 125 percent of FSD
10.	Capillary Glanding	: 1/2" NPT(M) x compression fitting (SS) to suit capillary
11.	Instrument Connection	: Bottom connection for local mounting, back connection for panel mounting
12.	Process Connection	: 1/2" NPT (M) or 150 RF Flanged
13.	Extension Neck Length	: 50 mm
14.	Compensation	: a) Capillary compensation
15.		: b) Case compensation
16.	Performance	: a) Accuracy : + /- 1.0 percent of full scale Deflection
		: b) Repeatability : Less than 0.5 percent of full range
		: c) Response time: 15 seconds (max.).
17.	Capillary length	: 3.0 meters (local) / 15.0 metres (local panel)
18.	Other features	: Shatter proof glass
19.	Nameplate	: Tag number, service engraved in stainless steel tag plate
20.	Accessories	: SS316 Thermowell
5.04.00	THERMOWELL	
1.	Material	: SS-316
2.	Manufacture	: Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)


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3. Process connection : M33x2
4. Certification : Not applicable
5. Bore concentricity : +5% of wall thickness
6. Identification mark : Tag number punched on head
7. Surface treatment : Polish after machining
8. Element connection : ½" NPT (M) or 150 RF Flanged
9. Head : Hex
10. Length of the hex head : 31.75 mm (min.)
11. Accessories : SS Plug and chain for test thermo wells
SS Nameplate, Flange with companion
flange & all required accessories for
flanged connections.

Note: Wake frequency calculations shall be furnished for all thermowells for approval.

Thermowells shall be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid.

5.05.00 METAL TEMPERATURE THERMOCOUPLE

1. Measuring medium : Metal temperature
2. Type : Chromel Alumel (Type-K)
Duplex, Ungrounded
3. Insulation : Mineral Insulation Magnesium Oxide
4. Wire gauge : 16 AWG
5. Protective sheath : SS
6. Protective sheath :
diameter : 8 mm O.D.
7. Characteristics : Special limits of error as in ANSI
thermocouple MC 96.01
8. Accessories : ½" BSP SS sliding end connector, weld
pad, clamps of heat resistant steel

1. Type : Hydrometer Type
2. Mounting : On line
3. Accuracy : +/- 2% of range
4. Scale : Black letter on white scale
5. End connection : PVC flange

9.06.00 DENSITY/ CONCENTRATION METER

1. Wetted Part : Stainless Steel
2. Enclosure : Stainless Steel (IP-65)
3. Power Supply : 24 V DC
4. Output signal : 4-20 mA DC (isolated) into 600 ohms
5. Accuracy : ± 0.001 g/cc
6. Indication : LCD display
7. Temp. Compensation : Integral
8. Accessories : Mounting hardware, integral amplifier
(if required), cable glands, tag plate
etc.

10.00.00 SOLENOID VALVES

1. Operating Principle : Electromagnetic (noiseless)
2. Coil voltage rating : 240 V AC /24 V DC (as required)
3. Ways : 2/3/4 way
4. Port size : 1/4" NPT all ports
5. Body : SS bar stock
- Trim : SS-316
6. Duty : Suitable for continuous energization
7. Sealing : Airtight and leak proof
8. Ambient Temperature : 0 - 50 ° C

-
9.	Fluid Temperature	:	0-150 ° C (approx.)
10.	Coil Enclosure	:	Stainless Steel
11.	Insulation	:	Class-H
12.	Coil Casing	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
13.	Mounting	:	On pipe or on panel
14.	Cable Connection	:	½" NPT
15.	Accessories	:	Cable glands, SS Tag plate


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Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 18.03.2015

SHEET

OF

Instrumentation Quality Plan

Praveen Kishore
SA Khan
VIVEK KUMAR



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST				P	V	V
4	ELECT. INSULATION/HV TEST	ONE	P	V	V		
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT	V	V	V		
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	V	V		
7	REVIEW OF TC OF MICROSWITCH	FOR LOT	V	V	V		

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and the same alongwith test certificates to be verified by BHEL



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

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P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material correlation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.

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 SA Khan Praveen Kishore



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION	ONE		P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST	FOR LOT	P	W	V		
4	OPERATION OF PRESSURE. RELIEF DEVICE	TYPE TEST	P	W	V		
5	REVIEW OF TC FOR	SEE NOTE-1 BELOW	V	V	V		
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION		V	V	V		
7	ACCESSORIES AS APPLICABLE		V	V	V		

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- When material correlation is not available, MFR's compliance to be provided
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR	ONE / LOT		P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 18.03.2015

SHEET

OF

**LCP and JUNCTION BOXES
SPECIFICATION**

Praveen Kishore
SA Khan
Praveen Kishore
Vivek Kumar
VIVEK KUMAR

- 1.00.00 **GENERAL REQUIREMENT**
- 1.01.00 ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT
- 1.01.01 All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.
- 1.02.00 SURFACE PREPARATION & PAINTING
- 1.02.01 All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.
- 1.02.02 Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.
- 1.02.03 Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:
- Exterior – Opaline green shade 275 of IS: 5 or equivalent international code..
 - Interior - Brilliant White.
- 1.02.04 Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.
- 1.03.00 WIRING
- 1.03.01 All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.
- 1.03.02 Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.
- 1.03.03 All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

- 1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.
- 1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices
- 1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- 1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.
- 1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.
- 1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- 1.03.10 Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.
- 1.03.11 Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue failure of the conductor.
- 1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation color-coding identified on drawings or by printed wiring lists.


VIVEK KUMAR
SA Khan Praveen Kishore

- 1.04.00 TERMINAL BLOCKS
- 1.04.01 All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.
- 1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.
- 1.04.03 The characteristics of the terminal blocks shall be as follows.
- i) High contact force, independent of conductor cross-section and large contact surface area.
 - ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
 - iii) Inspection and maintenance free (resistant to thermal aging and vibration)
 - iv) Low and constant voltage drop
- 1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.
- 1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.
- 1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.
- 1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.
- 1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

- 1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.
- 1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- 1.04.11 Other requirements of the terminal blocks are as follows:
- i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
- 1.05.00 **GROUNDING**
- 1.05.01 Separate Protective and Electronic system ground as required shall be provided.
- 1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.
- 1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground .The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open .The electronic ground between panels of a shipping section shall be firmly looped.
- 2.00.00 **CONTROL DESKS & PANELS**
- 2.01.00 **GENERAL**
- 2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping &

- accessories as required for completeness of the system.
- 2.01.02 The design shall conform to the EN ISO 11064 (Ergonomical design of Control Room), Part 1, 2 and 3.
- 2.01.03 The exact dimensions, material, construction details, grounding, general arrangement etc. shall be as per actual requirement and shall be finalized during detail engineering and subjected to Owner's approval.
- 2.01.04 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 2.01.05 For Control desk/ panel 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.
- 2.01.06 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 2.01.07 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
 - b) Nameplates for panels shall be provided both in front and rear.
- 2.02.00 CONTROL DESK
- 2.02.01 Control desk shall be free standing, floor mounting, table top type with doors at back and shall be constructed of 3 mm thick (minimum) CRCA steel or Aluminium extrusion. Aluminium structure shall be anodized or powder coated paint finish. The top surface of control desk shall be 30 mm (minimum) thick with the top 12 mm (minimum) of acrylic solid surface and the remaining 18 mm of laminated medium density fibre (MDF) board.
- 2.02.02 Monitors with retractable keyboard shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.
- 2.02.03 Desks shall be of modular, scalable and industrially ruggedized design and shall have connections for PA system handsets & telephone sets.
- 2.02.04 Desks shall have concealed cable trays for wire dressing. Both Horizontal & Side Managers (2 separate horizontal cable routing wire baskets for power & data cables) shall be provided.

Each User station will be provided with 2 separate power distribution units (1 for Main line & 1 for UPS line). Each power distribution unit will have 6 points of 5/13 Amp sockets, Mains MCB On/Off Switch & Indicator.

Adequate heat management provision for Exhaust of heat from within the Console Desk Assembly shall be provided. There will be multiple fans provided in the Main Control Desk. Each Fan will be of 230 VAC 250 CFM Ball Bearing based. Ventilation louvers will be provided on both Front & Rear Modesty with special Air Filters. Adequate space for CPU & Other equipments placed with in the desk.

2.02.05 Design shall include Earthing bolts.

2.02.06 Back installed items shall be suitably concealed from front view.

2.02.07 All operator workstations for SG, TG, Auxiliaries & Off-site Plants shall be mounted on this Control Desk. The cabling / wiring between OWS & CPUs, power supply cables etc. shall be aesthetically routed and concealed from view.

2.02.08 HARDWIRED DEVICES ON CONTROL DESK (DRAW OUT SECTION)

Release and Lamp Test push buttons shall be provided for a set of push buttons (decided during detail engineering stage). Depending on the type of control/ function, required number of push buttons/ indicating LEDs & their color, push button stations shall be selected. The size of push button stations shall be 24 x 48 mm or 25 x 50 mm and shall have service inscription details at the front. Emergency push buttons (with cover) shall be mounted on top of Control Desk.

2.03.00 BACK UP PANEL

2.03.01 Construction shall be from CRCA steel of thickness not less than 3mm.

2.03.02 Upright back-up panel shall be provided where hardwired devices shall be mounted on a mosaic grid type console. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat & flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.

2.03.03 DDCMIS Back-up Panel (referred as Unit Control Panel-UCP) shall also mount annunciation fascia (minimum 500 nos.) and the flame monitoring cameras along with other hardwired devices as decided during detail engineering stage by Owner. Color coding shall also subject to Owner's approval.

2.03.04 Colored Mimic for different Off-site plant control systems (as enumerated elsewhere in this specification) and hardwired annunciation system shall also

be mounted on the back up panels.

2.04.00 PANELS/CABINETS

2.04.01 All DDCMIS system modules, power supply components and other Local Control panels (PLC/Relay based) shall be housed in cabinets as specified below.

2.04.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings prior to shipment to the project site.

2.04.03 The Bidder shall ensure that the cabinets are complete & ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets shall only involve connections through multi-pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/ Back up Panel.

2.04.04 All electronic cards, network components, power supply modules etc. located shall be suitably housed in cabinets and shall be neatly arranged in sub-racks. Network components shall be visible in door closed condition (e.g. Glass doors etc.) as approved by Owner.

2.04.05 Bidder shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate.

2.04.06 The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Cooling Fans shall be provided wherever required and this shall be of industrial grade.

2.04.07 TECHNICAL PARTICULARS

1.	Material of Construction	:	Cold Rolled Coal Annealed (CRCA) steel sheet
2.	Thickness of Sheet	:	a) 2.0 mm for faces supporting instruments / terminals
		:	b) 1.6 mm for other sides and top
3.	Construction	:	Welded throughout as per approved National Standards
4.	Post welding operation	:	a) Grounding of all welds to smoothness
		:	b) Rounding of corners

- : c) Cleaning of weld spatters
- 5. Panel height : 2300 mm (approx)
- 6. Corners : 7 mm inner radius
- 7. Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm
 - c) Total for a group - 6 mm
- 8. Doors : Double, recessed, turned back edges, full height front & rear
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof
- 9. Gland plates : Removable in sections
4 mm thick (bottom)
- 10. Cable entry : Bottom
- 11. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC – 100 or equivalent for all sides
 - c) Stainless steel buff- finished 2 mm thick kick plate for all sides
 - d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws
 - e) Rubber strips to ensure air


 Vivek Kumar, SA Khan, Praveen Kishore

tightness between kick plate and finished floor

f) Lifting hook / Eye bolt

g) Drawing pocket

h) Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixtures

12. Name Plate	:	Both at front and back surface of the panel
13. Fixing of name plate	:	Stainless steel pan head screws
14. Name plate material	:	Laminated phenolic (3 layers)
15. Lettering	:	Black with white engraved
16. Mounting of terminal blocks	:	Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure

2.05.00 FURNITURE

All the furnitures in the Central / Local control Room (s), Engineers' rooms, Instrument laboratory , SWAS Room & any other rooms with C&I equipments located in different plant buildings under Bidder's scope shall be included in Bidder's scope of supply. Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe.

2.05.01 WORK STATION FURNITURE

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

2.05.02 PC RACK

PC Racks shall be provided to mount CPUs of workstations/PCs of OWS/LVS etc. in control room. For each PC / workstation / monitor at least one chair shall be included.

2.05.03 CHAIRS

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

2.05.04 TABLES

Industry standard computer tables shall be provided & shall be as approved by Owner during detailed Engineering. Glass top teak wood horse shoe shaped table with vertical file mounting arrangement (two layers to house approx. 40 Nos of files and lockable drawers at both ends) for Engineering Room shall be provided.

2.05.05 ALMIRAHs

Steel Almirahs shall be provided for keeping documents in the documentation room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed Engineering.

2.05.06 KEYPAD

One keypad per unit shall be provided for the storing of keys of relevant areas of the unit in the control room.

2.05.07 LOCKERS

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel. Also, lockers of bigger size shall be provided in documentation Room for storing of personal documents. Details shall be finalized and approved by Employer during detailed engineering.

3.00.00 LVS PANEL

3.01.00 An arc shaped Large Video Screen (LVS) panel shall be supplied for mounting large video screens in number of tiers in various Control rooms as specified elsewhere in this specification.

Bidder shall provide and fix ACP cladding around the LVS screen including covering the LVS back side and LVS stand. The cladding will be from floor finish to 600 mm above LVS screen like a self-standing partition with necessary openings for system requirement. ACP paneling shall be with 304 grade & approx. 0.5 mm mirror finish SS strip.

3.02.00 The profile, dimensions and the general arrangement shall be finalized & approved by Owner during detailed engineering. Recommendations, if any, for the control room lighting in order to ensure continuous proper viewing of the LVS screen by the operator & shift incharge (without any fatigue) shall be

- clearly brought out by the Contractor in his offer, alongwith all relevant details/basis.
- 3.03.00 Any other requirement for proper LVS mounting & functioning & viewing shall also be specifically brought out by the Contractor in his offer, along with all relevant details.
- 4.00.00 **LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)**
- 4.01.00 GENERAL
- 4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.
- 4.01.02 Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- 4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.
- 4.01.04 Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- 4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- 4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging
- 4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- 4.01.08 Earth stud shall be furnished at rack for safety grounding.
- 4.02.00 LOCAL INSTRUMENT ENCLOSURE (LIE)
- 4.02.01 Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.
- 4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- 4.02.03 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

member, which would reduce access, shall be avoided.

- 4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- 4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.
- 4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- 4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.
- 4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..
- 4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.
- 4.02.10 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- 4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations
- 4.03.00 LOCAL INSTRUMENT RACK (LIR)
- 4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or

falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.

4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.

4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.

4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack

4.03.06 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.04.00 JUNCTION BOX

1. Type of Enclosure	:	Dust tight & weatherproof conforming to IP 65
2. Material	:	3 mm sheet steel / fiberglass reinforced polyester(UV stabilized)
3. Type of Cover	:	Solid unhinged with retention chain / Screwed at all four corners
4. Paint	:	i) Exterior : Opaline green shade 275 of IS: 5 ii) Interior - Brilliant Glossy White.

- Surface / Two (2) inch Pipe stanchion
5. Mounting : (At a dry compartment at one side of the enclosure / rack with front opening type door)
6. Cable Entry : 3 mm (min) Bottom / side Gland plate
7. Gasket : Neoprene
8. Grounding : Brass earth lug with green screw head
External-2 nos , Internal-1no. (M6)
9. Number of Drain Holes : Two at bottom capped
10. Identification : Label for JB and Tags for cable
11. Accessories : Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
- b) Cable gland (Brass) & raceways
- c) Ferrules & lugs (Brass)
- d) Aluminum back panel
- e) Canopy at top
- f) Mounting brackets
- g) bolts and nuts made of brass etc.


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DATA SHEET FOR LOCAL PANELS

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

VOLUME

SECTION

REV. NO. 02

DATE: 16.09.2013

SHEET 1 OF 3

TAG No. Qty.....

Data Sheet No.: PES-145A-DS1-0

Data Sheet A & B

DATA SHEET-A FOR LOCAL PANEL
(TO BE FILLED BY PURCHASER)DATA SHEET-B
(TO BE FILLED-UP BY
BIDDER)

GENERAL	MANUFACTURER			
	CONSTRUCTION		☒ FOLDED ☐ WELDED	
	ENCLOSURE SHEET THICKNESS (As per Section 8.13, Volume V of contract specification)	FRONT	☐ 2.0 mm	
		OTHER	☐ 2.0 mm	
		DOOR	☐ 1.6 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. ☐ Other	
	OTHER	☐ Load bearing sheet front shall have 3mm thickness		
TECHNICAL	INPUT POWER SUPPLY * (As per Electrical specification) (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		☐ 240V 50 Hz AC ☐ 220V DC ☒ 415V 3 PHASE 3W ☐ 400V 3 PHASE 4W	
	NO. OF FEEDERS (As per Electrical specification)		☐ ONE ☐ TWO	
	STARTER WITH MCC		☐ REQUIRED ☒ NOT REQUIRED	
	IPR POSITION		☒ MCC ☐ RELAY PANEL	
	CONTACT RATING OF RELAY		☒ 5 Amp, 230 V AC ☒ 0.25 Amp, 220V DC	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____ NOS. (AS REQUIRED)	
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)		☐ REQUIRED ☒ NOT REQUIRED	
	PAINT TYPE (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ EPOXY ENAMEL ☐ EPOXY POWDER COATED	
	MIMIC (TYPE OF MIMIC- MATERIAL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		☒ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ LIGHT GREY ☐ OPALINE GREEN	
	FINISH (EXTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH (INTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		☒ IP-55 (FOR INDOOR SERVICE) ☒ IP-67 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE		☒ RELAY BASED	
	FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
WEIGHT OF PANEL (Kg.)		(Vendor to specify)		

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	DATA SHEET FOR LOCAL PANELS		SPECIFICATION NO.: PE-SS-999-145-054A	
			VOLUME	
			SECTION	
			REV. NO. 02	DATE: 16.09.2013
TAG No. Qty.....		Data Sheet No.: PES-145A-DS1-0		
Data Sheet A & B				
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	PANEL TYPE	☐ PRESSURISED ☐ UNPRESSURISED As per Requirement		
	CABLE GLAND	☒ DOUBLE COMPRESSION		
	AMMETER (TYPE OF INPUT) *	☐ 1 Amp CT ☐ 4-20 mA		
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING	☐ APPLICABLE ☒ NA		
	* TO BE CO-ORDINATED WITH PEM ELECTRICAL			
NAME DESIGNATION SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:
	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI	
	SR.ENGR	DY.MNGR	D. GM	
	16.09.2013	16.09.2013	16.09.2013	


 VIVEK KUMAR SA Khan Praveen Kishore



DATA SHEET FOR LOCAL PANELS

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

VOLUME

SECTION

REV. NO. 02

DATE: 16.09.2013

SHEET 3 OF 3

TAG No. Qty.....

Data Sheet No.: PES-145A-DS1-0

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER		
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)
	ENCLOSURE SHEET THICKNESS	FRONT	
		OTHER	
		DOOR	
		HEIGHT	
	OTHER		
TECHNICAL	INPUT POWER SUPPLY		
	NO. OF FEEDERS		
	CONTACT RATING OF RELAY		
	TEMP SCANNER		
	CONTROL SUPPLY		
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		
	PAINT TYPE		
	PANEL COLOUR (EXTERNAL)		
	FINISH (EXTERNAL)		
	TYPE OF MIMIC MATERIAL OF MIMIC THICKNESS OF MIMIC		
	PANEL COLOUR (INTERNAL)		
	FINISH (INTERNAL)		
	CLASS OF PROTECTION		
	CONTROL HARDWARE		
	FOUNDATION ARRANGEMENT		
WEIGHT OF PANEL (Kg.)			

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VIVEK KUMAR

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PE-SS-999-145-054A	
				VOLUME	
				SECTION	
				REV. NO. 02	DATE: 16.09.2013
			SHEET 3 OF 3		
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0		
Data Sheet C					
DATA SHEET-C FOR LOCAL PANEL (TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)					
	PANEL TYPE				
	CABLE GLAND				
	AMMETER (TYPE OF INPUT)				
	SCOPE OF SUPERVISION				
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY		COMPANY SEAL NAME: SIGNATURE: DATE:
	AANCHAL CHOUDHARY	SACHIN SRIVASTYAVA	MA MANSOORI		
	16.09.2013	16.09.2013	16.09.2013		

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 Praveen Kishore



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 18.03.2015

SHEET

OF

LCP Quality Plan


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 STD QUALITY PLAN NO.: PE-QP-999-145-1056		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										VOLUME IIB SECTION D REV. NO. 01 DATE: 22-02-2008 SHEET 1 OF 7			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
									P	W	V				
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Relevant standard	Relevant standard	Test Certificate	3	---	2				
		2. Bend Test	CR	Mech. test	Sample	Relevant standard	Relevant standard	Log Book	2	---	---				
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---				
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---				
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---				
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1				
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Relevant standard	Relevant standard	Log Book	2	---	---				
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---				
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---				
		4. Mill marking	MA	Visual	100%	Relevant standard	Relevant standard	Log Book	2	---	1				
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---				
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---				

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

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

1 - BHEL
 2 - Vendor
 3 - Sub-vendor


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 STD QUALITY PLAN NO.: PE-QP-999-145-1056		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL											
		VOLUME		SECTION		REV. NO.		DATE:		SHEET			
		IIB		D		01		22-02-2008		2 OF 7			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	
									P	W	V		
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---		
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	3	---	2		
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100%	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2 2	---	---	---	+ for relay & contactors only @ for all components except relays & contactors.

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-I056					
PEM :: C&I										VOLUME		IIB			
										SECTION		D			
										REV. NO.		01		DATE: 22-02-2008	
										SHEET		3		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	P	W	V	Remarks			
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA MA MA	Visual Visual Electrical	Sample Sample Sample	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	Log Book Log Book Log Book	2 2 2	--- --- ---	--- --- ---				
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Factory Standard	Approved Mfr. drgs. Factory Standard	Log Book Log Book	2 2	--- ---	--- ---				
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Approved Mfr. drgs.	Approved Mfr. drgs. Approved Mfr. drgs.	Log Book Log Book	2 2	--- ---	--- ---				
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA MA MA MA	Measurement Measurement Visual Visual	100% 100% 100% 100%	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Log Book Log Book Log Book Log Book	2 2 2 2	--- --- --- ---	2 2 2 2				
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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056			
										VOLUME IIB			
										SECTION D			
										REV. NO. 01 DATE: 22-02-2008			
										SHEET 4 OF 7			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
9.0	Pre-treatment and Painting	1. Pretreatment Process 2. Process parameters like bath temp. concentration etc. 3. Dipping / Removal Time 4. Surface quality after every dip 5. Primer after phosphating 6. Putty Application & Rubbing after primer 7. Paint first coat 8. Putty Application and Rubbing after first coat of paint 9. Paint second coat	MA MA MA MA MA MA	Visual Measurement Measurement Visual Visual, Thickness Visual Visual, Thickness Visual Visual, Thickness, Scratch test Colour adhesion	100% Periodic 100% 100% 100% 100% 100%	Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard	Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard	Log Book Log Book Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2 2 2	--- --- --- --- --- --- --- --- ---	1 		

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056											
PEM :: C&I										VOLUME IIB											
										SECTION D											
										REV. NO. 01		DATE: 22-02-2008									
										SHEET 5		OF 7									
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks									
									P	W	V										
10.	Panel Wiring	1. Wiring Layout 2. Wiring Termination (Crimped Lugs) 3. Ferrule numbers 4. Colour of wiring 5. Size of Conductor	MA MA MA MA MA	Visual Visual Visual Visual Measurement	100% 100% 100% 100% 100%	Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs.	Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs.	Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2	--- --- --- --- ---	--- --- --- 1 1										
11.	Component Mounting	1. Correct components 2. Fixing	MA MA	Visual Visual	100% 100%	Approved drgs., Specs. & BOM Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM Approved drgs., Specs. & BOM	Log Book Log Book	2 2	--- ---	--- ---										
12.	FINAL Final Inspection	1. Workmanship 2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components 3. Components identification Marking / Name plates	MA MA MA	Visual Visual Visual	100% 100% 100%	Factory Standard BHEL approved drg. / Spec. BHEL approved drg. / Spec.	Factory Standard BHEL approved drg. / Spec. BHEL approved drg. / Spec.	Inspection Report Inspection Report Inspection Report	2 2 2	1 1 1	1 1 1	At Random by BHEL, based on 100 % internal test reports by Mfr.									
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics														\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.				1 - BHEL 2 - Vendor 3 - Sub-vendor			

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

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 STD QUALITY PLAN NO.: PE-QP-999-145-1056		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056						
		PEM :: C&I					VOLUME IIB											
							SECTION D											
							REV. NO. 01 DATE: 22-02-2008											
							SHEET 7 OF 7					7 OF 7						
Format of Records			Agency \$			Remarks												
Acceptance Norms	Reference documents	Extent of Check	Type/Method of Check	* Category	Characteristics Checked							Component / operation	Sl. No.	P	W	V		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	---	1							
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1							
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1							
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1							
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant standard	BHEL approved spec/drg & relevant standard	Inspection Report	2	1	1							

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Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: PE-TS-410-145-I		
VOLUME		
SECTION		
REV. NO.	00	DATE : 18.03.2015
SHEET	OF	

PC SPECIFICATION

Praveen Kishore
SA Khan
Praveen Kishore

Vivek Kumar
VIVEK KUMAR

SPEC NO.: PE-TS-410-145-I

VOLUME

SECTION

REV. NO.

00

DATE : 07.03.2015

SHEET

OF

a. CPU

1. Processor : Intel core i5 or better, 32 bit
2. RAM : 4 GB min. and expandable to 16 GB
3. Hard Drive : 500 GB or more
4. Removable bulk storage : DVD (R/RW)
5. Graphic accelerator : 8MB (minm.)
6. Graphic Memory : dedicated 1GB or better
7. Operating System : Windows 7 or better
8. Audio controller : 16 bit
9. Communication Port : 2 serial, one parallel, 8 USB, Dual 100Mbps Ethernet
10. Expansion Slot : 3
11. Cache : 512 KB Level 2
12. Video Card : PCI

b. MONITOR

1. Type	:	LCD COLOUR MONITOR
2. Screen Diagonal	:	24" (approx.) flat
3. Display	:	XGA or better
4. Resolution	:	1024 by 768 or better
5. Degree of Protection	:	IP-30
6. External Controls	:	Brightness, contrast, Horizontal/Vertical, amplification & Shift
7. Version	:	To suit Industrial application

Pauline S. Brown
D. Brown



Technical specification for
Computer
For
1X800 MW Kothagudem

SPEC NO.: PE-TS-410-145-I

VOLUME

SECTION

REV. NO.

00

DATE : 07.03.2015

SHEET

OF

c. KEY BOARD & MOUSE

1. Type : Flat spill proof membrane or positive depression type ASCII
2. Life Expectancy : 50 million cycles per key
3. Version : To suit Industrial application
4. Mouse : Optical mouse

d. SOFTWARE

Diagnostic Software, Anti Virus, Microsoft office, Acrobat Adobe Software and other application software.

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SA Khan Praveen Kishore



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: PE-TS-410-145-I		
VOLUME		
SECTION		
REV. NO.	00	DATE : 18.03.2015
SHEET	OF	

FURNITURE SPECIFICATION

Praveen Kishore
SA Khan
Praveen Kishore
Vivek Kumar
VIVEK KUMAR



Technical specification for
FURNITURE
For
1X800 MW Kothagudem

SPEC NO.: PE-TS-410-145-I

VOLUME

SECTION

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SPECIFICATION FOR FURNITURE

- a) 4 Nos. cushioned revolving, independently adjustable seat and back chairs.
- b) Glass top Teak wood / MDF table for mounting Operator Station monitors.
- c) Printer tables.
- d) Glass top Teak wood / MDT table for System Engineering Room / Engineering stations with drawer at end.
- e) Glass top teak wood / MDF table with vertical file mounting arrangement (two layer to house approx. 40 Nos of files and lockable drawers at both end) for System Engineering Room / Engineers.

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Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

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OF

CABLE BOQ


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SA Khan Praveen Kishore

CABLE SIZES FOR 1X800 MW KOTHAGUDEM TPS	
Sl no.	Cable Type
	G-TYPE
1	2P X 0.5 sqmm
2	4P X 0.5 sq mm
3	8P X 0.5 sqmm
4	12P X 0.5 sqmm
5	2P X 1.5 sqmm
	F-TYPE
1	4P X 0.5 sqmm
2	8P X 0.5 sqmm
3	12P X 0.5 sqmm
4	20P X 0.5 sqmm
	CONTROL CABLE
1	3C X 2.5 sqmm
2	5C x 2.5 sq mm
3	12C x 2.5 sqmm


 Vivek KUMAR

 SA Khan



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

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DATE : 18.03.2015

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OF

KKS PHILOSOPHY

Praveen Kishore
SA Khan
Praveen Kishore
Vivek Kumar
VIVEK KUMAR



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

1X800MW KOTHAGUDEM

KKS NUMBERING PHILOSOPHY

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

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

X	X	X	A A Y			Y B B	B		

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

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

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

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


 VIVEK KUMAR SA Khan Praveen Kishore

	DOCUMENT TITLE KKS NUMBERING PHILOSOPHY 1X800 MW KOTHAGUDEM																																												
ANNEXURE-1 List of System / Sub-System Codes used in Power Plant: 1) Compressed air system : QEA, QEC 2) Ventilation System : SAA TO SAZ 3) Fire Detection & Protection System + Fire Water pumps : SGM, SGN, SGO, SGP 4) Sewage Treatment : SJA TO SJZ 5) Pre-treatment Plant : GBI, GBM, GBV 6) RO DM Plant : GCI, GCM, GBV 7) AC SYSTEM : QKA,QKB TO QKZ ANNEXURE-2 Standard Equipment Codes: <table> <tr><td>AA</td><td>Valves including drives, also hand operated</td></tr> <tr><td>AB</td><td>Seclusions, Lock, Gates, Doors</td></tr> <tr><td>AC</td><td>Heat Exchanger</td></tr> <tr><td>AE</td><td>Turning, Driving, Lifting equipment</td></tr> <tr><td>AF</td><td>Continuous conveyors, Feeders</td></tr> <tr><td>AG</td><td>Generator Units</td></tr> <tr><td>AH</td><td>Heating and Cooling Units</td></tr> <tr><td>AK</td><td>Pressing and Packaging equipment</td></tr> <tr><td>AM</td><td>Mixer, Stirrer</td></tr> <tr><td>AN</td><td>Blower, Air Pumps / Fans, Compressor Units</td></tr> <tr><td>AP</td><td>Pump Units</td></tr> <tr><td>AT</td><td>Purification, Drying, Filter</td></tr> <tr><td>AV</td><td>Combustion Equipment e.g. grates</td></tr> </table> Standard Apparatus Codes: <table> <tr><td>BB</td><td>Vessels and Tank</td></tr> <tr><td>BF</td><td>Foundation</td></tr> <tr><td>BG</td><td>Boiler Heating Surfaces</td></tr> <tr><td>BN</td><td>Injector, Ejector</td></tr> <tr><td>BP</td><td>Flow and throughput limitation equipment (Orifice)</td></tr> <tr><td>BQ</td><td>Holders, Carrying Equipment, Support</td></tr> <tr><td>BR</td><td>Piping, Ducts, Chutes, Compensator</td></tr> <tr><td>BS</td><td>Sound Absorber</td></tr> <tr><td>BU</td><td>Insulations, Sheatings</td></tr> </table>		AA	Valves including drives, also hand operated	AB	Seclusions, Lock, Gates, Doors	AC	Heat Exchanger	AE	Turning, Driving, Lifting equipment	AF	Continuous conveyors, Feeders	AG	Generator Units	AH	Heating and Cooling Units	AK	Pressing and Packaging equipment	AM	Mixer, Stirrer	AN	Blower, Air Pumps / Fans, Compressor Units	AP	Pump Units	AT	Purification, Drying, Filter	AV	Combustion Equipment e.g. grates	BB	Vessels and Tank	BF	Foundation	BG	Boiler Heating Surfaces	BN	Injector, Ejector	BP	Flow and throughput limitation equipment (Orifice)	BQ	Holders, Carrying Equipment, Support	BR	Piping, Ducts, Chutes, Compensator	BS	Sound Absorber	BU	Insulations, Sheatings
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 SA Khan Praveen Kishore



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

1X800 MW KOTHAGUDEM

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level
CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3**Numerical Keys****A) Numerical Keys at System Code Level**

- i) Use 10, 20, 30, ... To distinguish between main systems having same Alpha Codes. Examples:
 - a) Main Steam (Left) and Main Steam (Right)
 - b) BFP – A/B/C
 - c) ID Fan – A/B, FD Fan A/B, AH – A/B
- ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.
- iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

- i) Valves and Dampers --- *Equipment Code – AA*

N1N2 N3

DOCUMENT TITLE			
	KKS NUMBERING PHILOSOPHY		
	1X800 MW KOTHAGUDEM		
Motorised (<i>on/off duty</i>)	-	0	01 to 50
Motorised (<i>inching duty</i>)	-	0	51 to 99
Pneumatic (Control)	-	1	01 to 50
Motorised (<i>thyrestor Control</i>)	-	1	51 to 99
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99
NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99
ii) Field Instruments			
Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			
Example of Numerical Key Usage:			
In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ... Where system code is same.			

Checked: 
 VIVEK KUMAR
 SA Khan Praveen Kishore



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: PE-TS-410-145-I		
VOLUME		
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LIST OF DELIVERABLES


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SA Khan Praveen Kishore

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR MAUX PACKAGES							
1X800MW KOTHAGUDEM TPS							
DOCUMENT NUMBER PE-GL-410-145-I100							
SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION							
1	PE-V9-410-553-I901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I	
2	PE-V9-410-553-I902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I	
3	PE-V9-410-553-I903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I	
4	PE-V9-410-553-I904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I	
5	PE-V9-410-553-I905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I	
PLC PANEL							
1	PE-V9-410-553-I906	PLC CONFIGURATION DRAWING	A	A	VENDOR	C&I	
2	PE-V9-410-553-I907	PLC PANEL GA (INTERNAL & EXTERNAL) DRAWING	A	-	VENDOR	C&I	
3	PE-V9-410-553-I908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I	
4	PE-V9-410-553-I909	PLC INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I	
5	PE-V9-410-553-I910	UPS BATTERY CHARGER/ BATTERY DATASHEET & SLD	I	\$\$	VENDOR	C&I	
6	PE-V9-410-553-I911	UPS SIZING CALCULATIONS	I	-	VENDOR	C&I	
7	PE-V9-410-553-I912	BATTERY SIZING CALCULATIONS	I	-	VENDOR	C&I	
8	PE-V9-410-553-I913	CONTROL DESK LAYOUT / GA DRAWING	A	-	VENDOR	C&I	
9	PE-V9-410-553-I914	PLC-OWS/PRINTER FURNITURE BOM	A	-	VENDOR	C&I	
10	PE-V9-410-553-I915	PLC CONTROL ROOM LAYOUT DRAWING	A	-	VENDOR	C&I	
11	PE-V9-410-553-I916	PLC CATALOGUE	I	-	VENDOR	C&I	
12	PE-V9-410-553-I917	PLC QUALITY PLAN & FAT PROCEDURE	A	-	VENDOR	C&I	
13	PE-V9-410-553-I918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	`	VENDOR	C&I	
14	PE-V9-410-553-I919	PROCESS GRAPHIC MANUSCRIPTS PLC	I	-	VENDOR	C&I	
15	PE-V9-410-553-I920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I	
16	PE-V9-410-553-I921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I	
17	PE-V9-410-553-I923	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	-	VENDOR	C&I	
18	PE-V9-410-553-I924	PANEL HEAT DISSIPATION DATA	I	-	VENDOR	C&I	
19	PE-V9-410-553-I925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I	
20	PE-V9-410-553-I926	PLC O & M MANUAL	I	-	VENDOR	C&I	
21	PE-V9-410-553-I927	PLC EARTHING SCHEME	I	-	VENDOR	C&I	
	Notes:	410 - Project No					
		XXX -SI No of MAX Package					
		\$\$ -Approval by BHEL if Vendor BBU Item Approval by Customer if Customer BBU Item					

**C&I MANDATORY SPARES LIST FOR
AUXILIARY PACKAGE
FOR 1 X 800 MW KOTHAGUDEM**


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C&I MANDATORY SPARES FOR AC SYSTEM FOR 1 X 800 MW KOTHGUDEM		
A	Field Instruments	
1	Transmitters/ Gauges/Switches etc. along with relevant accessories	10% of total or at least two (whichever is higher) for each type along with accessories.
2	Temperature Element (RTD/Thermo-couple) with thermowell	10% of each type , range and immersion length . Minimum 5 nos.
3	Furnace Temperature Probe	Thermocouple 1 no.
B	Control Panel/Desk Mounted Items	
1	Back-up panel mounted devices (Selector switches/ Push buttons/ Indicators etc.)	5% of installed capacity
2	Lamps/ LEDs	100% of the total quantity
3	Blank Tiles	10% of installed capacity
4	MCBs	10% of each type & rating
5	Fuses/ Fuse holder	100% of each type & rating
C	Actuator	
1	Complete set of Actuator	1No. for each type and rating
2	Limit Switch	3 Nos each type and rating
3	Torque Switch	3 Nos each type and rating
4	Auxiliary Contact	1 no each type and rating
5	Motor	1 no each type and rating
6	Complete Seal kit	1Set for each type and rating
7	Complete O-Ring Set	1Set
8	Electronic Card	One(1) for each type/make
9	Feedback Assembly (4-20mA) for Inching type	One(1) for each type/make
D	UPS (For BOP systems)	
1.1	Fuse	3 (Three) times of total quantity of each type of fuses used in the system (for all BOP systems).
1.2	SCR	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.

1.3	Diode	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.
1.4	IGBT	2 (two) nos.
1.5	Electronic Module/ PCB	
1.5.1	Static Switch	1 (one) no. each type of ElectronicCard/ PCB/ modules used in the system
1.5.2	Inverter	1 (one) no. each type of ElectronicCard/ PCB/ modules used in the system
1.5.3	Static voltage Regulator	1 (one) no. each type of ElectronicCard/ PCB/ modules used in the system
1.5.4	Charger	1 (one) no. each type of ElectronicCard/ PCB/ modules used in the system
1.5.5	UPS of 2 KVA rating or below.	One Complete set.
1.5.6	Selector Switch	1 (one) no. each type
1.5.7	Digital Voltage/ Current Indicator (LCD type)	1 (one) no. each type
1.5.8	Indication Lamp- Complete assembly (Red/ Green colour)	1 (one) no. each type
1.5.9	Cooling Fan - 240 VAC supply	1 (one) no. each type
1.6	UPS Battery	
1.6.1	Battery Cell (Uncharged, Dry)	10% of total quantity of each BOP UPS.
1.6.2	Inter connecting cell strips	10 nos.
1.6.3	Rubber gloves	1 pair
1.6.4	Voltmeter for measuring cell voltage(Center zero type)	1 no.
1.6.5	Apron & Goggles	1 set
1.6.6	Cell lifting puller	1 no.
1.6.7	Insulated socket spanner with handle	1 no.
1.6.8	Terminal screw with bellaville washer	10% of total quantity used
1.6.9	Thermometer	1 no.
E	PLC/ Proprietary Control System	
1	Network cards, Communication Interface cards	5% for each type or but minimum 1 no.
2	I/O Cards (Each type)	5% for each type but minimum 1 nos.
3	Controller Cards	2 nos.
4	SER Cards	5% for each type or but minimum 1 no.

5	All other Electronic Modules	5% for each type but minimum 1 no.
6	Relays	10% of total quantity
7	Power Supply Modules & Power Packs for control system	5% for each type and range but minimum 1 no.
8	Network Items (Network switch/ LIU unit/ Transceiver/ FO patch cord etc.)	10% for each type or but minimum 1 no.
9	MCB (Miniature case circuit breaker)	10% for each type or but minimum 1 no.
10	Fuses	200% each type and rating
11	Racks for housing I/O & Processor Modules	1(One) no. each type used in the system
12	Prefab interconnecting cables with connectors	10% of total nos. used in the system or minimum 4(four) nos. whichever is more for each type.
13	Network communication cable with end connectors	10% but minimum 1
14	I/O bus cables with connectors for remote I/O units	1 no. of each type & length
15	Fibre optic cable Converter / Deconverter	1 no.
16	Cooling Fans	10% but minimum 1
17	Loose Connectors	5 nos. of each type
18	Colour TFT Monitor	1 no. complete set
19	Hard Disk Drive for the work Station	1 no. complete set
20	Key board , mouse / trackball with connecting cables and plugs	1 no. each type.
21	Printers Catriges	2 nos. of each type
22	SMPS for printers	1 no. of each type/ rating
23	SVGA cards for printers	1 no. of each type
24	Key Board & Cursor control device	1 no. of each type
25	Complete Set of Operators Work Station	1no. complete set
26	Terminal Block	10% of total nos. used in the system for each type and rating.
27	Read-Write CD/DVD	10% but minimum 1
28	Blank CD/DVD	50 (fifty) nos.


 Official
 Project Officer
 G.T. Road
 Pimpri Chinchwad
 Pune



TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
AIR-CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-410-553-A001

VOLUME II B

SECTION C5

REV. 00

DATE: APRIL 2015

SECTION: C5

MATERIAL HANDLING SPECIFICATION


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SA Khan Praveen Kishore



TECHNICAL SPECIFICATION FOR
ELECTRIC HOIST
1X800 MW KOTHAGUDEM TPS

SPECIFICATION NO. PE-TS-410-XXX-AXXX

VOLUME II - B

SECTION-C5

REV 00

DATE APRIL 2015

Material Handling Equipment

Praveen Kishore
 VIVEK KUMAR - SA Khan - Praveen Kishore



**TECHNICAL SPECIFICATION FOR
ELECTRIC HOIST
1X800 MW KOTHAGUDEM TPS**

SPECIFICATION NO. PE-TS-410-XXX-AXXX

VOLUME II - B

SECTION-C5

REV 00

DATE APRIL 2015

1. ELECTRIC HOIST

Required number of electric hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas where handling weight is more than 2000 kg.

Electric wire rope hoist shall be designed to duty class 2 as per IS: 3938 (latest). The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.

DESIGN CRITERIA

For the hoists with more than 2.0 tonne lifting capacity and/ or more than 10.0 M lift i.e. either capacity or lift is more than 2T or 10 m, Electrical hoist shall be provided.

However, all monorails coming out of the building shall be provided with electric hoist block, irrespective of load and lift.

Capacity of electric hoists shall be decided keeping 20% margin over heaviest equipment to be handled.

For electric hoist, operator shall be able to control the movement of the electrical hoist with the help of floor operated pendant

MINIMUM LIFTING REQUIREMENT

Sl. N.	Area / Equipment description	Qty. (nos)	Capacity (T)	Lift (m)	Travel (m)
1					

Note;

1. Area, type, capacity mentioned are minimum requirement and shall be finalized during detail engineering without any commercial implication
2. Travel and Lift are layout dependent and shall be finalized during detail engineering without any commercial implication

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**TECHNICAL SPECIFICATION FOR
ELECTRIC HOIST
1X800 MW KOTHAGUDEM TPS**

SPECIFICATION NO. PE-TS-410-XXX-XXXX

VOLUME II - B

SECTION-C5

REV 00

DATE APRIL 2015

1.0 SCOPE OF SUPPLIES

Equipment and services to be furnished by the bidder for the ELECTRIC HOIST with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified in the specification but required to make the ELECTRIC HOIST complete and efficient operation shall also be under the bidder's scope of work.

Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

2.1.0 ELECTRIC HOIST

Electric hoist shall include but not be limited to the following: -

- a. Hoisting and CT drive arrangement
- b. All electrical equipment including cables (as per electrical scope matrix) and panels.
- c. PVC insulated shrouded bus bar DSL
- d. Earthing arrangement.
- e. VVVF Drive for hoisting motion.
- f. Fill of lubricant till commissioning / handling over to customer.
- g. Painting of electric hoist and accessories.
- h. Maintenance tools & Tackles
- i. Erection & Commissioning spares
- j. Isolating switch in enclosure at operating floor for disconnecting supply to DSL while maintaining the electric hoist.
- k. Mandatory spares

2.2.0 Erection and Commissioning spares

The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.

2.3.0 Services to be provided by the bidder

Packing, forwarding and transportation to site, storage and handling at site.

2.4.0 Erection and Commissioning

2.5.0 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant Indian standards)

2.6.0 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.

3.0 Inspection and Testing

Inspection and testing shall be carried out as per enclosed standard quality plan approved QAP and as per IS 3938 (latest revision). Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement/ CHP (Customer Hold Point) at any stage of inspection deemed necessary by Customer during detailed engineering shall be carried out without any commercial or technical implication.

4.0 Works Excluded

Supply of ISMB monorail.

5.0 PAINTING SPECIFICATION

As per Annexure-I.

6.0 PACKING

VIVEK KUMAR
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**TECHNICAL SPECIFICATION FOR
ELECTRIC HOIST
1X800 MW KOTHAGUDEM TPS**

SPECIFICATION NO. PE-TS-410-XXX-AXXX

VOLUME II - B

SECTION-C5

REV 00

DATE APRIL 2015

As per packing details specified elsewhere in specification.

7.0 DEMONSTRATION TEST

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP and as per IS 3938 for electric hoist

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

8.0 MAKE OF SUB - VENDOR ITEMS

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client.

9.0 TESTING AT SITE

A) ELECTRIC HOIST:

As required for statutory clearance for operating at site i.e., overload test, load test and other tests as per IS 3938.

Test for Operation -After the supply has been connected, tests shall be carried out to prove the following:

- The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavorable conditions;
- The correctness of all circuits and interlocks and sequence of operation; and
- The satisfactory operation of all protective devices.

Overload Test -After test but before the hoist is put into service, it shall be tested with overload relays appropriately set, to lift and sustain a test load of 125 percent of the working load. During the overload test, the hoist shall sustain the load under full control. The specified speeds need not be attained but the hoist shall show itself capable of dealing with the overload without difficulty.

VIVEK KUMAR SAKHAI Praveen Kishore



1 X 800 MW KOTHAGUDEM

DOC. NO.

REV.

DATE:

Annexure I

PAINTING SPECIFICATION

Surface preparation: De greasing and Mechanical cleaning with wire brush or hand tool. (SA 1/ ST 2 / ST 3 as applicable)

Primer : chlorinated rubber based zinc phosphate 1 coat, DFT50 μ per coat.

Intermediate : chlorinated rubber based paint pigmented with Titanium Dioxide 1 coat, DFT50 μ per coat

Finish Coat : chlorinated rubber based 1 coat, DFT 50 μ per coat.

Total DFT : 150 μ

Electrical /Control Panel:

Surface preparation: Seven tank process

Primer : Zinc phosphate (Alkyd medium) - 2 coat Minimum DFT 25- 35 μ per coat.

Finish Coat : Synthetic enamel (Alkyd medium) as per IS: 2932- 3 coats, Minimum DFT 20-25 μ per coat.

Total DFT : 110 - 145 μ

Color Shade:

SL. No	Item Description	Color Shade	Remarks
1	Structure	Lemon yellow, shade 356 as per IS-5	
2	Bottom block assembly	Lemon yellow, shade 356 as per IS-5	
3	Hooks	Lemon yellow, shade 356 as per IS-5	With 100 mm wide black zebra strip
4	End carriage sweep	Lemon yellow, shade 356 as per IS-5	
5	Motors	Smoke Gray 692 as per IS 5	
6	Control Panels	Steel grey/ As per purchaser practice	


VIVEK KUMAR
SA Khan Praveen Kishore

VOLUME : IIIF

SECTION-III

MISCELLANEOUS HOISTS

1.00.00 GENERAL INFORMATION

1.01.00 The hoists will be used for erection and maintenance of various equipment in different buildings.

1.02.00 Hoists are divided into two separate groups - (a) Hand operated and (b) Electric operated.

2.00.00 CODES AND STANDARDS

The design, manufacture and testing of the equipment covered under this specification shall conform to the latest editions of the following Indian Standards:

2.01.00 IS : 3832 : Specification for Hand Operated Chain Pulley-blocks.

2.02.00 IS : 807 : Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists.

2.03.00 IS : 6216 : Short link Chain, Grade T(8) for Pulley-blocks & other Lifting Appliances.

2.04.00 IS : 4164 : Lifting 'C' Hooks with Eye Capacity upto 25 tonnes.

2.05.00 IS : 2429 (part -I) : Non-calibrated Load Chain for Lifting Purposes.

2.06.00 IS : 3938 : Specification for Electric Wire Rope Hoists. and other Indian Standards referred to in the above standards.

3.00.00 SCOPE OF WORK

3.01.00 Hoists shall be provided in all areas where any equipment/component weighing above 500 kg is installed and needs to be handled for maintenance purposes. Number of monorail beams shall be such that the centre line of the hoist and the centre line of equipment to be handled shall be not more than 500 mm.

- 3.01.01 The location and no. of hoists is to be finalised during detailed engineering. Final arrangement is subject to approval of Owner/Consultant.
- 3.01.02 Monorail hoists shall at least be provided in the areas mentioned in Annexure-I. The list is indicative only and not an exhaustive one.
- 3.02.00 All drive motors and driving gears as necessary.
- 3.03.00 Limit switches for electrical hoist as necessary.
- 3.04.00 Trailing cable with all supporting fixtures as necessary for electric hoists.
- 3.05.00 Pendant control station with all accessories for electric hoists.
- 3.06.00 Lifting lug, eye bolts etc., for handling hoist parts.
- 3.07.00 Protection guard as specified.
- 3.08.00 Lifting hook block assembly for hoists.
- 4.00.00 **SPECIFIC DESIGN REQUIREMENTS**
- 4.01.00 Lifting capacity
- 4.01.01 Capacity of each hoist shall be 1.2 times the maximum working load.
- 4.02.00 ~~**Effort for Mechanical Hoists**~~
- 4.02.01 Hoisting
- Hoisting effort for hoists upto 3 tones capacity shall not be more than 20 kg.
- Hoisting effort for hoists above 3 tones capacity shall not be more than 25 kg
- 4.02.02 Trolley Motion
- Effort for trolley motion for hoists upto 3 tones capacity shall not be more than 15 kg.
- Effort for trolley motion for hoists above 3 tones capacity shall not be more than 20 Kg.
- 4.02.03 For Electric operated hoist both hoisting and trolley motion shall be motor operated.
- 4.03.00 **Lift**

4.03.01 Lift above operating floor

Highest position of the hook shall be such that during operation of hoists, the vertical distance between bottom of any equipment handled and top of any permanent structure or equipment in the operating area shall be at least one metre.

4.03.02 Approach below operating floor

To be decided by the Bidder for safe and reliable handling of any equipment above half ton below the operating floor.

4.04.00 ~~Length of Monorail Hoist~~

~~To be decided by the Bidder depending on the floor and machine layout. The horizontal distance between the centre line of the hoist and centre line of any installed equipment in its operating shall not be more than half metre.~~

5.00.00 **DESIGN AND CONSTRUCTION**

5.01.00 All parts requiring replacement or lubrication shall be easily accessible without the need for dismantling of other equipment and structures.

Robust construction and ample rating merging which experience has shown to be necessary shall be ensured throughout manufacture.

5.02.00 All components of hoists of identical capacity and duty shall be interchangeable. The hoists of identical capacity and duty shall be identical in all respects unless otherwise required. The hoist design shall be such that these can be quickly removed from one monorail beam and fixed on another beam without disassembling major components.

5.03.00 All machinery and equipment included under this specification must be equipped with safety devices and clearances to comply with recognized standards and specification requirements.

5.04.00 Cast iron parts wherever used, shall conform to IS:210 - FG 260. Also no wood or other combustible materials shall be used.

5.05.00 Defects in material like fractures, cracks, blowholes, laminations, pitting etc. are not allowed. Rectifications of any such flaw is permissible only with the approval of the Purchaser.

5.06.00 Each hoist shall be permanently and legibly stamped with the tag number, manufacturer's name, safe working load, grade of load chain (where applicable), range of lift etc.

- 5.07.00 Load chain (where applicable) shall be of grade T(8) as per IS:6216 and Hand chain shall be as per IS:2429 (Part-I) grade 30.
- 5.08.00 Wheels in trolley unit travel shall be single flanged with straight/tapper/barrel shaped tread to suit the monorail. Wheels should be preferably of forged steel construction. Material of construction for wheels of traversing block and hoist gear for hoist used in hazardous areas shall be of non-ferrous material to avoid spark during operation.
- 5.09.00 All gears shall be hardened and tempered steel with machine out teeth.
- 5.10.00 **Hoist (Manually Operated)**
- 5.10.01 Manually operated hoists shall be of spur gear chain pulley block type. It shall be suspended from the trolley by a hook. The design of the hoist shall conform to IS:3832 (Specification for hand operated chain pulley blocks). The hooks and brakes of hoist shall conform to the requirements stipulated in (a) and (b) below
- a) Hooks shall conform to and IS:3832. The load hook shall be swivelling type fitted with a locking device.
 - b) The pulley blocks shall be fitted with an automatic mechanical load brake to prevent self lowering of load in all working positions. The load brake shall also allow smooth lowering of load without serious overheating.
 - c) All manually operated hoists, unless stated otherwise, shall be trolley suspended type.
- 5.10.02 The trolley of hoists shall be manually operated.
- 5.10.03 The hoists shall be of Mechanism class 2 as per IS:3832.
- 5.11.00 **Electric Hoist**
- 5.11.01 Electric hoist shall be electric wire rope trolley suspended type. The design, operation, testing of electric hoist shall conform to IS:3938 (Specification for electric wire rope hoist).
- Minimum speed for hoisting shall be 3 m/min. and that of for trolley motion shall be 15 m/min.
- 5.11.02 Lifting hook shall conform to IS-4164 as applicable.
- 5.11.03 Wire rope for hoists shall conform to IS-2266.
- 5.11.04 Electro-mechanical brakes of fail to safety type shall be provided for hoist motion as well as per trolley motion for electrically driven trolley. Load brake shall allow smooth lowering of load and arrangement shall be such as it can not be released accidentally. Capacity of brake and other relevant data shall conform to IS:3938.

- 5.11.05 The trolley of the hoists shall be electrically driven.
- 5.11.06 For other components of hoist such as rope, sheave, drum, bearings, gears etc. stipulations of IS: 3938 shall be followed.
- 5.11.07 Motor shall be rated for duty S4. Service class of motor shall be "M8" as per IS:3177. Conditions given in IS:3938 for hoist motor shall be followed over and above the specification of electric motor in Volume-V. In case of any contradiction of the aforesaid standard and the motor specification, the conditions which are more stringent shall be considered. All the motors shall be suitable for reversing, frequent starting and braking. Motors shall be provided with suitable space heating arrangement.
- 5.11.08 Hoist shall be designed so that remote control can be effected by means of pendant push button switch from the operating floor. Operation, arrangement etc. of pendant push button switch shall conform to IS:3938.
- 5.11.09 Micro-speed attachment in hoist shall be provided if considered necessary by the Bidder.
- 5.11.10 The hoists shall be of mechanism class 2 as per IS-3938.
- 5.12.00 Ball and roller bearings of reputed make shall be used throughout.
- 5.13.00 Suitable lubrication system shall be provided for all gear drives.
- 5.14.00 **Other Electrical Items**
- 5.14.01 The cross conductor on monorail for power supply to the hoist shall be of festoon type flexible insulated cable conductors. All fixtures and accessories shall be provided by the Bidder for this purpose.
- 5.14.02 Necessary insulators, supports, clamps and all other accessories shall be provided as per standard design.
- 5.14.03 Each hoist shall be provided with a starter panel with protective relays.
- 5.14.04 One main isolating switch shall be used to cut-off the supply to the hoist assembly.
- 5.14.05 One main electro-magnetic contactor together with magnetic overload relay (hand reset) for each motor circuit shall be housed in the protection panel.
- 5.14.06 The operation of overload relay shall interrupt the main magnetic contactor.
- 5.14.07 Adequate short circuit protection shall be provided for main and individual circuits.
- 5.14.08 415V $\pm$ 10%, 3 Phase, 4 Wire, 50 Hz $\pm$ 5%, power supply for the hoist shall be arranged through MCCB unit mounted at standing height at a convenient location near each hoist.

- 5.14.09 Transformers to step down the voltage and rectifiers as necessary shall be provided by the Bidder.
- 5.14.10 All external and internal power, control and auxiliary circuit wiring of the electrical drive and accessories and panels shall be provided. The wiring shall be done with 1100 V grade PVC insulated stranded aluminium conductor cable of suitable size not less than 2.5 sq.mm nominal equivalent copper area of cross-section. All control and auxiliary circuit wiring shall be done with 1100 V grade PVC insulated, 2.5 sq.mm stranded copper conductor. Control wire terminations to the panels shall be made with compression type connectors. Multiway terminal blocks shall be furnished for terminating panel wiring and outgoing cable.
- 5.14.11 The hoist structure, motor frame and metal cases of all electrical equipment including metal conduit shall be effectively connected to earth. All grounding materials shall be supplied under this specification to grounding risers.
- 5.14.12 Single speed control shall be used for both hoist and trolley travel in each direction of motion.
- 6.00.00 **INSPECTION AND TESTING**
- 6.01.00 The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of the specification and in compliance with the requirements of the latest edition of IS:3832 or equivalent standards for manually operated hoists and shall be as per IS:3938 for electrically operated hoist.
- 6.02.00 All the mono-rail hoists shall also be tested at site as per the stipulation of relevant Indian Standards.
- 7.00.00 **DRAWINGS, DATA AND INFORMATION**
- 7.01.00 General arrangement drawings incorporating all dimensions information on head rooms, lift, wheel loads, hook suspension arrangement and other relevant data for all the hoists.
- 7.02.00 For Mandatory Spares, Spares required for erection and commissioning, Recommended Spares, Special Tools And Tackles, fixtures etc., as required for regular operation and maintenance of the equipment offered and supply of first charge of lubricating oil, inhibitor oil and also adequate quantity of the consumables,
- 7.03.00 Design calculation for selection of electric motor capacities for electric hoist.
- 7.04.00 Complete list of location, number and capacity of hoists provided.

11.01.17.5 **Rock-Toe, Rip-Rap Works, Rr Masonary**

Rock toe shall be formed with rock material consisting of sound, durable and well-graded broken rock obtained from approved quarries and shall be of approved quality. The materials shall range in size from 10 to 45 cm. QA&QC test for rock-toe, rip-rap works shall be carried out in line with the Technical Specification, PART-B.

11.01.17.6 **Slope Protection Works**

Slope protection works with dry brick packing or ash-cement/ soil-cement mortar ash cement concrete on the slopes, confined within brick masonry panel walls shall be constructed with approved quality of materials. Slope protection works with turfing on downstream slope shall be as per IRC standards. Slope protection works with ash cement concrete on the downstream slopes shall be constructed with approved quality of materials. QA&QC tests for slope protection works shall be carried out in line with the Technical Specification, PART-B.

11.01.17.7 **Bentonite Liner**

Construction Quality Control (CQC) tests as indicated in Table shall be performed by the Contractor's Quality Control Team at regular intervals upon completion of the Soil-Bentonite liner.

QCQ Requirements for Impervious Liner

Parameter	Test Frequency per layer
Moisture Content	1 per 5,000 Cum
Field Density	1 per 5,000 Cum
Falling Head Permeability	1 per 25,000 Cum

All CQC test results shall achieve the required values as established by the engineer. Failure to achieve these values shall require re-working of the Impervious mixture in the failed areas.

12.00.00 **SHOP TEST EOT CRANES, OTHER CRANES & HOIST**

1.0 **Hooks**

1.1 All tests including proof load test as per relevant IS/BS/DtN shall be carried out.

1.2 MPI/DPT shall be carried out after proof load test.

2.0 **Steel Casting**

2.1 DPT on machined surface shall be carried out.

3.0 Girders, end carriage, crab, gear box and rope drum

3.1 The plates of thickness 25mm and above shall be ultrasonically tested.

3.2 NDT requirements on weldments shall be as follows:

a)	BUTT WELDS IN TENSION	:	100% RT AND 100% DPT
b)	BUTT WELDS IN COMPRESSION	:	10% RT AND 100% DPT
c)	BUTT WELDS IN ROPE DRUM	:	100% RT AND 100% DPT
d)	FILLET WELDS	:	RANDOM 10% DPT

4.0 Forging (Wheel, Gears, Pinions, Axle, Hooks & Hook Trunion)

4.1 All forgings greater than or equal to 50 mm diameter or thickness shall be subjected to ultrasonic testing.

4.2 DPT/MPI shall be done after hardfacing and machining.

5.0 Wire rope shall be tested as per relevant standard.

6.0 Reduction gears shall be tested for reduction ratio, backlash & contact pattern. gear box shall be subjected to no-load run test to check for oil leakage, temperature rise, noise and vibration.

7.0 The cranes shall be completely assembled at shop for final testing. all tests for dimension, deflection, load, overload, hoisting motion, cross travel etc. as per IS-3177 shall be carried out at shop.


Sakshi Praveen Kishore

VIVEK KUMAR

	MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT						
	AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	WIRE ROPE ELECTRIC HOIST					
					REV	0	CONTRACT No						
					DATE		CONTRACTOR	BHEL					
					PAGE	1 of 4							
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	M	C	N	REMARKS
1	2	3	4	5	6	7	8	9		**	10		11
2.3*	WELD SET UPS	DIMENSIONS	MA	MEAS. , VISUAL	100%	WPS, APPD. DRG.	WPS, APPD. DRG.	INSPN. REPORT		P	V		
2.4*	WELDMENTS -FINAL RUN	SURFACE DEFECTS	MA	PT	100%	IS:3658 / ASTM:165	ASME SEC. VIII DIV. I	INSPN. REPORT	√	P	V	V	
2.5	TRUNION / TROLLEY WHEELS, GEARS PINION	SURFACE & INTERNAL FLAWS (FOR DIA. / THICKNESS >50MM)	MA	PT / UT	100%	ASTME:165	NO LINEAR DEFECTS / NOTE-4	INSPN. REPORT	√	P	W	V	
2.6	NDT OF LOAD BEARING BUTT WELDS (IF ANY)	WELD QUALITY OF a)Butt weld on tension 100% RT and 100% DPT b)Butt weld oncompression 10% RT and 100% DPT c)Butt weld on rope drum 100% RT and 100% DPT d) Fillet	CR	PT & RT	100%	ASME SEC. VIII DIV. I	ASME SEC. VIII DIV. 4 - CLUW-51 FOR RT APPENDIX -8 FOR PT	INSPN. REPORT ND FILM	√	P	V	V	FILMS TO BE REVIEWED BY BHEL & Customer. DPT SHALL BE CHP FOR Customer & BHEL
2.7	GEAR BOXES												
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS	MA	MEAS.	100%	MFG. DRG.	MFG. DRG.	INSPN. REPORT	√	P	V		
	Gear shall be checked for reduction ratio, backlash & contact pattern.	CHECK FOR OIL LEAKAGE, VIBRATION, NOISE TEMP. RISE	MA	NO LOAD RUNNING FOR TWO HOURS	100%	MFG. DRG.	MFG. STD.	- DO -	√	P	V	V	
2.8	ELECTRICALS												
1	MOTORS	TYPE TESTS (INCLUDING DEGREE OF PROTECTION)	MA	TYPE TESTS	1 / TYPE, 100%	IS:3938	IS:3938	MFRS' TEST CERT., INSPN REPORT	√	P	V	V	
		ROUTINE TESTS		ROUTINE TESTS	100%	IS 325	IS 325	DO	√	P	V	V	
2	RESISTANCES (IF APPLICABLE)	TEMPERATURE RISE	MA	VERTIFICATION OF MFRS' TEST CERT.	100%	IS:3938, RELV. ISS	IS:3938, RELV. ISS	MFRS' TEST CERT.	√	P	V	V	
3	CONTROLLER, LIMIT SWITCHES (IF APPLICABLE)	ROUTINE TESTS	MA	ROUTINE TEST	100%	IS:6975/TECH. SPEC.,	IS:6875/TECH. SPEC.,	MFRS' TEST CERT.	√	P	V	V	Rating and make to be verified.
4	BRAKES	ROUTINE TESTS	MA	ROUTINE TEST	100%	TECH. SPEC. / IS:15560	IS:3938/TECH. SPEC.	MFRS' TEST CERT.	√	P	V	V	
5	BRAKE DRUM (IF APPLICABLE)	VERIFICATION OF HT CHARTS, HARDNESS (IF APPLICABLE)	MA	VISUAL, HARDNESS TEST	100%	APPD. DRGS./TECH. SPC.	APPD. DRGS./TECH. SPEC.	HT. CHART /INSPN. REPORT	√	P	V	V	
6	CONTACTOR	ROUTINE TESTS	MA	ROUTINE TEST	100%	IS:2959 AND TECH. SPEC., IS:6547 / IS:3938	IS:2959 AND TECH. SPEC., IS:6547 / IS:3933	INSPN. REPORT	√	P	V	V	Rating and make to be verified.
7	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICKNESS	MA	VISUAL	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	INSPN. REPORT	√	P	V	V	BOUGHT OUT ITEMS AS PER BHEL / CUSTOMER APPROVAL LIST
		LEGND											
		* RECORDS IDENTIFIED WITH TICK(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION											
		** M: MANUFACTURER/SUBCONTRACTOR											
MANUFACTURER/ SUB CONTRACTOR	CONTRACTOR	C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL) N: CUSTOMER											
		INDICATE 'P' PERFORM"W" WITNESS AND "V" VERIFICATION AS											

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT				
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	WIRE ROPE ELECTRIC HOIST			
					REV	0	CONTRACT No					
					DATE		CONTRACTOR	BHEL				
					PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS	
									D*	M	C	N
1	2	3	4	5	6	7	8	9		**	10	11
SIGNATURE			APPROPRIATE "CHP" CUSTOMER SHALL IDENTIFY IN COLUMN "N"				REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL				
8	CABLES	TYPE AND ROUTINE TESTS	MA	TYPE & ROUTINE TESTS	100%	AS PER TECH. SPEC. IS:1554/IS:9968- PART - 1 / IS:694 / RELEVANT IS FOR FRLS CABLES	AS PER TECH. SPEC. IS:1554/IS:9968- PART - 1 / IS:694	MNFRS' TEST CERT.	✓	P	V	V
3.0	FINAL INSPECTION											
3.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, OVERALL DIMENSIONS	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	✓	P	W	V
3.2	ASSEMBLED HOIST PERFORMANCE	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:3938	IS:6547 / IS:3938	MNFRS' TEST CERT.	✓	P	W	V
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTRACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION	CR	MEAS & VISUAL	100%	IS:6547 / IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	✓	P	W	V
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	✓	P	W	V
3.3	OVER LOAD TEST	1. OVER LOAD	CR	TEST AT 125 % OF-SWL	100%	IS:6547/IS:3938	IS:6547/IS:3938	INSPN. REPORT	✓	P	W	V
4	PAINTING											
1	PRIMER & FINISHING AND SHADE	1. TO RELEVANT IS	MI	CORRECTNESS OF MFG. TEST CERT.	EACH CONSIGNMENT	DRG. & DATA SHEET & RELV. IS SPEC.	DRG. & DATA SHEET & RELV. IS SPEC.	MNFRS' TEST CERT.		P	V	
	NOTE:											
* 1.0 Clause from 2.1 to 2.4 shall be applicable for load bearing welded joints.												
2.0 Back Wall Echo shall be adjusted to 100% of Full Screen Height in sound (Defect Free) Area. Defect Echo Height more than 20% of Screen Height shall be treated as unacceptable. Back Wall Echo shall not be less than 80% of Screen Height in any case.												
			LEGENDS									
* RECORDS IDENTIFIED WITH 'TICK' (✓) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION												
** M: MANUFACTURER/SUBCONTRACTOR												
MANUFACTURER/ SUB CONTRACTOR		CONTRACTOR	C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL) N: CUSTOMER									
SIGNATURE		INDICATE 'P' PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE "CHP" CUSTOMER SHALL IDENTIFY IN COLUMN "N"				REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL					



TECHNICAL SPECIFICATION FOR ELECTRIC HOIST 1X800 MW KOTHAGUDEM TPS

SPECIFICATION NO. PE-TS-410-XXX-AXXX

VOLUME II - B

SECTION -C1

REV 00

DATE APRIL 2015

1.0 TECHNICAL DATA SHEET:

A) ELECTRIC HOIST:

Sl.no	DESCRIPTION	TECHNICAL PARTICULARS
1.0	Type	Steel wire electric hoist with electrically operated trolley
2.0	Scope (Qty., Capacity, Lift, Travel Length)	As per specification and layout requirement
3.0	Type of service	Indoor
4.0	Overload test	125% of SWL
5.0	Design Ambient temperature	50° C
6.0	General Design	As per IS: 3938 / 1983 or latest, Class-II duty
7.0	Operating speed	Full Speed Creep Speed
7.1	Hoisting speed	3 MPM. 10% of main speed
7.2	Trolley speed	15 MPM NA
8.0	Type of transmission	Through Electric motor and gear box.
9.0	Wire Rope	
9.1	Construction / core	6 x36/ 6X37 (Steel core / fibre core)
9.2	Code	IS:2266
9.3	Number of falls	Min. 4
9.4	Factor of safety	Not less than 5
10.0	Load Hook and block	NORMALISED HOOK ONLY
10.1	Type of load hook	Plain shank trapezoidal section with safety latch.
10.2	Load hook Code	IS: 15560
10.3	Load hook Material	As per IS:15560
10.4	Hook suspension	Thrust bearing
10.5	Material of block suspension	Fabricated from steel plate, Material: IS: 2062
11.0	Gearing	
11.1	Type	Spur / Helical
11.2	Gear/ pinion material	as per IS 3938
11.3	Lubrication	Oil splash/ grease lubricated
11.4	Bearing type	Antifriction Ball / Roller
12.0	Trolley drive	
12.1	Wheel	Single flange taper thread
12.2	Wheel conform to (Std. / code)	IS: 3938



**TECHNICAL SPECIFICATION FOR
ELECTRIC HOIST
1X800 MW KOTHAGUDEM TPS**

SPECIFICATION NO. PE-TS-410-XXX-AXXX

VOLUME II - B

SECTION -C1

REV 00

DATE APRIL 2015

12.3	Wheel material	C55Mn75/ En-8/ En-9. (Max hardness 200 BHN)	
12.4	Bearing type	Antifriction Ball / Roller	
12.5	Trolley type	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels.	
12.6	Hardness	Max hardness 200 BHN	
13.0	SHEAVE		
13.1	Material	Fabricated from steel plate. IS: 2062 Gr. A or Gr. B / as per IS: 3938	
13.2	Bearing type	Antifriction Ball / Roller.	
14.0	BRAKE (HOIST and TROLLEY)		
14.1	Type	DC EM brakes disc type (fail to safe).	
14.2	Capacity	As per IS 3938.	
14.3	Number	One number for each motor.	
15.0	ROPE DRUM		
15.1	Material	Seamless steel pipe. ASTM A106 / 53 grade B/Fabricated	
15.2	Flange / Flangeless	Flanged	
15.3	Type of groove	As per manufacturers standard to suit the layout requirement.(Shall be decided during detail engineering)	
17.0	TYPE OF DSL		
17.1	CT travel	PVC Shrouded bus bar cu conductor type DSL	
18.0	MOTORS		
18.1	Type	Sq. Cage induction, TEFC, S4 duty, 40% CDF.	
18.2	Number of start	150 starts / hr	
18.3	Voltage , Phase and Frequency	415V $\pm$ 10%, 3 phase, 4 wire, 50 Hz	
18.4	Class of insulation	Class "F" and temperature rise limited to class B.	
18.5	Type of enclosure	TEFC	
18.6	Degree of protection provided for enclosure	IP-55	
18.7	Margin	Motor rating will be calculated keeping margin of at least 15% over the maximum power requirement in the duty condition specified.	
19.0	LIMIT SWITCHES	Hoisting	Trolley
19.1	Type	Snap action, self actuating type	Lever type
20.0	Control panel	* Fabricated from Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion	



**TECHNICAL SPECIFICATION FOR
ELECTRIC HOIST
1X800 MW KOTHAGUDEM TPS**

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		plate of 3mm thick. * Degree of protection shall be IP 54. * Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos earthing terminals on panel. * 20 % spares terminals (clip on type) shall be provided. * Power and control terminals (clip on type) shall be on separate channels. * Gland plate shall be double brass compression type.
20.1	Qty	1 No.
21.0	Pendent Push buttons	Up /down / forward / Reverse push buttons. Indicative marking for easy operation shall be provided.
22.0	Power cables	Cu cable in line with specification
23.0	Control cable	Cu cable in line with specification
24.0	Control Voltage	110 V

2.0 Maintenance Tools and Tackles

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied for each EH/CPB. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox. The items supplied shall be of the best quality, specially protected against rusting. The following shall be provided as minimum requirement:

S-No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set
2	Complete set of screwdrivers (Indicate the sizes)	1 Set
3.	Adjustable Spanner	1 No.
4.	Insulated plier	1 No.
5.	Grease gun	1 No.
6.	Oil gun	1 No.
7.	Line tester	1 No.
8.	Wrench spanner	1 No.
9.	Hand Lamp.	1 No.

Note: - Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

3.0 DRAWING/DOCUMENT SUBMISSION

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:



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Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-XXX-563-A100	Manufacturing Quality Plan with Sub vendor list
2	PE-V0-XXX-563-A101	GA Drawing for Electric Hoist, DSL arrangement and painting details
3	PE-V0-XXX-563-A102	Schematic Circuit Diagram
4	PE-V0-XXX-563-A103	Mechanism Sizing Calculation
5	PE-V0-XXX-563-A104	Detailed BOM/BOQ for EH
6	PE-V0-XXX-563-A105	O & M Manual including Erection procedure
7	PE-V0-XXX-563-A106	Mandatory spare parts list

Notes;

- The above drawing list is tentative and shall be finalized with the successful bidder after placement of order.
- Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
- All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:
 - All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
 - Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
 - Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 etc

4.0 MANDATORY SPARES: (As Applicable)

As per list below.

1.11	HOISTS (for each type and rating, hoists)	
1.11.1	Bearings for long travel wheels	2 sets
1.11.2	Bearings for gear boxes for each type of hoist	2 sets
1.11.3	Break liners for all the brakes	100% of total population of each type & size
1.11.4	Oil seals	100% of total population of each type, size rating
1.11.5	Brake springs for all brakes	-do-
1.11.6	Wire ropes for hooks	100% installed on each crane and hoist
1.11.7	Solenoid coils for brakes	2 sets



**TECHNICAL SPECIFICATION FOR
ELECTRIC HOIST
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1.11.8	Overload relay for motors	2 Nos.
1.11.9	Limit switches for hoists and travel mechanisms	2 sets
1.11.10	Spare motors for hoists	2 Nos.
1.11.11	Long travel machinery	
	i. Gear wheel	1 set
	ii. Internal clip	2 Nos.
	iii. Pinion	1 No.
2	Electrical Items	
2.1	Trailing Cable	One set of full length of each size/type of cables as used for each type of Electrical Hoist
2.2	415 Volt Motor (Up to 30KW Rating)	
a	Driving End & Non-Driving End Bearing	3Set for each type and rating of Motor
b	Cooling Fan	2No. for each type and rating of Motor
c	Motor Terminal Block	5Nos. for each type and rating of Motor
d	Complete Set of Coupling	1Set for each Application
2.3	Control Panel/ Desk Mounted Items	
2.3.1	Push Button	
2.3.1.1	Complete assembly	5 nos. of each color
2.3.1.2	Contact Element (1NO-1NC) Blocks	20Nos.
2.3.2	Selector Switch	10 Nos. of each type and rating
2.3.3	Meter (Analog or digital)	
2.3.3.1	Ammeter	10% for each type & range or minimum 1 no. whichever is more
2.3.3.2	Voltmeter	10% for each type & range or minimum 1 no. whichever is more
2.3.3.3	Frequency	10% for each type & range or minimum 1 no. whichever is more
2.3.3.4	MW	10% for each type & range or minimum 1 no. whichever is more
2.3.3.5	MVAR	10% for each type & range or minimum 1 no. whichever is more
2.3.3.6	Power Factor	10% for each type & range or minimum 1 no. whichever is more
2.3.3.7	Synchroscope	10% for each type & range or minimum 1 no. whichever is more
2.3.4	Indicating Lamps complete assembly	10 Nos. of each colour & type
2.3.5	Mimic Lamps	10 Nos. of each colour & type
2.3.6	MCB	2 Nos. for each type and rating
2.3.7	Door limit Switch	2 Nos.
2.3.8	Annunciation System	
2.3.8.1	Lamp Box with Facia & Lamps (LED Type)	25 Nos.
2.3.8.2	Hooter	1 No.
2.3.8.3	Each Type of PCB (for non-PLC driven system)	1 No.


 VIVEK KUMAR, SA Khan, Praveen Kishore



**TECHNICAL SPECIFICATION FOR
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5.0 MAKES:**MAKES OF ELECTRIC HOIST AS PER LIST BELOW:**

Package Name	Vendor Name
ELECTRIC HOIST	Alpha Services
	CONSOLIDATED HOISTS PVT LTD
	CENTURY CRANE ENGINEERS PVT. LTD.
	EDDY CRANES PVT. LTD.
	Grip Engineers Pvt. Ltd.,
	GLOBAL TECHNOLOGIES
	HERCULES HOISTS LTD.
	LIFTING EQUIPMENTS and ACCESSORIES
	Mangla Hoists Pvt Ltd
	REVA INDUSTRIES LTD.
	ROCKWELL HOISTO CRANES PVT. LTD.
	SAFEX ENERGY PVT. LTD.
	TUOBRO FURGUSON (INDIA) PVT LTD

Note: No other make will be acceptable, until and unless specifically got approved by BHEL/Customer / Customer's consultant during detail engineering only. Acceptance/non acceptance of same shall not have any impact on manufacturing, delivery schedule and on cost of the Electric hoists

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO ELECTRIC HOIST:

Sl no.	ITEM	MAKES
1.0	STEEL	SAIL / JINDAL /ESSAR
2.0	HOOKS	SMRITI FORGING / STEEL FORGING & ENGG. CO., KOLKATA/KARACHIWALLA
3.0	GEAR COUPLINGS	ALLIANCE / HICLIFF / OEM
4.0	WIRE ROPE	USHA MARTIN Black / FORT WILLIAMS /BHARAT WIRE ROPES.
5.0	BEARINGS	SKF/ FAG
6.0	MOTORS	SIEMEN/ ABB /NGEF/ CROMPTON /KIRLOSKAR / BHARAT BIJLI / MARATHON
7.0	BRAKES	STROM CRAFT/ ELECTROMAG /SPEED-O- CONTROL
8.0	CONTACTOR	SIEMENS / L&T /SCHNEIDER / BCH
9.0	OVER LOAD RELAYS	SIEMENS / L&T / SCHNEIDER / ABB
10.0	HRC FUSES	SIEMENS / L&T/ ENGLISH ELECTRIC/GE Power
11.0	ISOLATING SWITCH	SIEMENS/ L&T / CONTROL & SWITCH GEAR/ABB
12.0	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL/ & SWITCH GEAR/ ABB
13.0	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ SCHNEIDER
14.0	TRANSFORMERS	INDCOIL/AE / LOGICSTAT/ PRAGATI / KAPPA / SOUTHERN ELECTRIC
15.0	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS/ BAJAJ/ CROMPTON
16.0	CABLE LUGS (HEAVY DUTY)	DOWELLS
17.0	CABLES	
a)	POWER CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT / FINOLEX/ POLYCAB/KEI
b)	CONTROL CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER / DELTON / FINOLEX / TORRENT / CCI / ICL / RADIANT / KEI.
c)	TRAILING CABLE	NICCO /UNIVERSAL/INCAB/ICL/KEI/



**TECHNICAL SPECIFICATION FOR
ELECTRIC HOIST
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18.0	CABLE GLAND	COMMET / SIEMEN / SUNIL&CO.
19.0	PUSH BUTTONS	SIEMENS / L&T / BCH /SCHNIDER
20.0	LIMIT SWITCHES	SPEED-O-CONTROL / ELECTROMAG / JAI BALA JI
21	SELECTOR SWITCHES	KAYCEE/ SULZER
23	INDICATING LAMPS	TECKNIC / BCH / SIEMENS / STANDARD/ VAISHNO
24	MCB	MDS / INDO COPP / STANDARD
25	PANELS	OEM/BCH
26	DSL	SUSHEEL/STROMAG
27	TERMINAL BLOCKS	ELMEX/CONNECTWELL/WAGO (FOR CONTROL ONLY)
28	VVVF	YASAKAWA(L&T)/ABB/SIEMENS/SCHNIDER
29	CASTING	KOLHAPUR STEEL / GNAT FOUNDARY / KIRTI ALLOYS
30	Tools & tackles	Reputed make

Note : 1 All the trailing cables shall be sourced from only one sub-vendor from the list
 2 No other make will be acceptable, until and unless specifically got approved by BHEL/Customer / Customer's consultant during detail engineering only. Acceptance/non acceptance of same shall not have any impact on manufacturing, delivery schedule and on cost of the Electric hoists/ CPB

Praveen Kishore
 VIVEK KUMAR - SA Khan - Praveen Kishore

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: ELECTRIC HOIST FOR AC PLANT

PROJECT : 1X 800 MW KOTHAGUDEM TPS

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

<u>S. NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V(3ph 3 W) supply feeder only up to isolating switches for cranes. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	Vendor	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	Vendor	
4	Equipment Earthing	Vendor	Vendor	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
5	Motors	Vendor	Vendor	
6	Cable glands and lugs 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 & control cables.
7	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.



TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
AIR-CONDITIONING SYSTEM
LIST OF MAKES

SPECIFICATION NO. PE-TS-410-553-A001

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ANNEXURE-I
LIST OF MAKES


VIVEK KUMAR
SA Khan Praveen Kishore

	TECHNICAL SPECIFICATION 1X800 MW KOTHAGUDEM AIR-CONDITIONING SYSTEM LIST OF MAKES	SPECIFICATION NO. PE-TS-410-553-A001	
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Sl. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMAVENETA
3	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
4	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
5	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRYAIR (FLAKT) / EDGETECH / ETHOS / SYSTEM AIR
6	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
7	CHILLED & CONDENSER WATER PUMP	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON
8	COOLING TOWER	PAHARPUR / MIHIR / BELL
9	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE
10	AIR FILTER	FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM
11	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / KRUGER / MARATHON / C DOCTOR
12	INSULATION MATERIAL	K-FLEX / ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
13	BALANCING VALVE	ADVANCE
14	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / KEYSTONE
15	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / BANKIM & COMPANY
16	GATE/GLOBE VALVES	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR
17	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY / JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL
18	MOTORIZED BUTTERFLY VALVE	ANERGY / ADVANCE / BELIMO / JOHNSON / HONEYWELL / SIEMENS
19	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / DS ENGG / SAROJINI
20	PIPING - ERW	SURYA ROSHNI / TISCO / TATA / BST / JINDAL / SAIL
21	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS

	TECHNICAL SPECIFICATION 1X800 MW KOTHAGUDEM AIR-CONDITIONING SYSTEM LIST OF MAKES	SPECIFICATION NO. PE-TS-410-553-A001	
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22	GI SHEETS FOR DUCTING	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / TATA / SAIL / JINDAL
23	FIRE DAMPER	TSC / CARRIAIRE / RAVISTAR (SYSTEM AIR)
24	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
25	STRIP HEATER	ESCORTS / DASPASS/ ALCO/ HEATCO
26	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
27	RELIEF / PURGE VALVE	BRASSOMATIC
28	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL
29	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
30	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
31	PRESSURE GAUGE	GENERAL INST CONSORTIUM / BELL / H.GURU INST / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST
32	TEMPERATURE GAUGE	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / A.N.INST / H GURU (SI)
33	LEVEL GAUGE	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL/ TECHNOMATIC / LEVCON / D K INSTRUMENTS
34	PRESSURE SWITCH / DP SWITCHES	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS
35	TEMPERATURE SWITCH	INDFOSS/ SEIMENS / DANFOSS/ DK INSTRUMENTS/ TOSHNIWAL / SWITZER
36	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS
37	LEVEL SWITCH	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / LEVCON / DK INSTURMENT / V ATUOMATE / SIMENS /
38	TRANSMITTERS	TAYLOR / ABB/BRISTOL BABCOCK / BIRLA KENT TAYLOR / BLISS ANAND /SBEM/ SMART INST / FISHER-ROSEMOUNT/ SIEMENS/ TATA HONEYWELL
39	SIGHT FLOW INDICATORS	SIGMA / LEVCON /V AUTOMAT /EUREKA / TATA HONEYWELL
40	FLOW ELEMENT	BRISTOL BABCOCK / BALIGA /LIGHTING EQUIP /ENGINEERING SPECIALITIES /IL
41	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM/ PYRO ELECTRIC / DETRIVE INST & ELECTRONICS / TOSHNIWAL
42	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA /TRAC / FLOW STAR/ SCIENTIFIC DEVICE
43	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
44	PLC BASED PANEL	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB
45	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO
46	PRINTER	HP / CANON / EPSON / XEROX / IBM

	TECHNICAL SPECIFICATION 1X800 MW KOTHAGUDEM AIR-CONDITIONING SYSTEM LIST OF MAKES	SPECIFICATION NO. PE-TS-410-553-A001	
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47	UPS	HITACHI-HIREL / APC / DELTA / EMERSON
48	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
49	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
50	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
51	METERING PUMP	SHAPO TOOLS / VK PUMPS
52	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE
53	PRESSURE TRANSMITTER	ABB / SIEMENS / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
54	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL
55	ROTAMETER	CHEMTROLS SAMIL / EUREKA IND / IL / TRANSDUCERS AND CONTROL
56	BATTERY CHARGER	AMARARAJA/ CHHABI ELECTRICAL / DUBAS ENGG. / CALDYNE
57	BATTERY (NI -Cd)	HBL POWER / AMCO SAFT / SAFT


VIVEK KUMAR
SA Khan Praveen Kishore



**MAIN VENDOR AND SUB VENDOR FOR
ELECTRIC HOIST
1X800 MW KOTHAGUDEM TPS**

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MAKES:**MAKES OF ELECTRIC HOIST AS PER LIST BELOW:**

Package Name	Vendor Name
ELECTRIC HOIST	Alpha Services
	CONSOLIDATED HOISTS PVT LTD
	CENTURY CRANE ENGINEERS PVT. LTD.
	EDDY CRANES PVT. LTD.
	Grip Engineers Pvt. Ltd.,
	GLOBAL TECHNOLOGIES
	HERCULES HOISTS LTD.
	LIFTING EQUIPMENTS and ACCESSORIES
	Mangla Hoists Pvt Ltd
	REVA INDUSTRIES LTD.
	ROCKWELL HOISTO CRANES PVT. LTD.
	SAFEX ENERGY PVT. LTD.
	TUOBRO FURGUSON (INDIA) PVT LTD

Note: No other make will be acceptable, until and unless specifically got approved by BHEL/Customer / Customer consultant during detail engineering only. Acceptance/non acceptance of same shall not have any impact manufacturing, delivery schedule and on cost of the Electric hoists

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO ELECTRIC HOIST:

Sl no.	ITEM	MAKES
1.0	STEEL	SAIL / JINDAL / ESSAR
2.0	HOOKS	SMRITI FORGING / STEEL FORGING & ENGG. CO., KOLKATA/KARACHIWALLA
3.0	GEAR COUPLINGS	ALLIANCE / HICLIFF / OEM
4.0	WIRE ROPE	USHA MARTIN Black / FORT WILLIAMS /BHARAT WIRE ROPES.
5.0	BEARINGS	SKF/ FAG
6.0	MOTORS	SIEMEN/ ABB /NGEF/ CROMPTON /KIRLOSKAR / BHARAT BIJLI / MARATHON
7.0	BRAKES	STROM CRAFT/ ELECTROMAG /SPEED-O- CONTROL
8.0	CONTACTOR	SIEMENS / L&T /SCHNEIDER / BCH
9.0	OVER LOAD RELAYS	SIEMENS / L&T / SCHNEIDER / ABB
10.0	HRC FUSES	SIEMENS / L&T/ ENGLISH ELECTRIC/GE Power
11.0	ISOLATING SWITCH	SIEMENS/ L&T / CONTROL & SWITCH GEAR/ABB
12.0	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL/ & SWITCH GEAR/ ABB
13.0	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ SCHNEIDER
14.0	TRANSFORMERS	INDCOIL/AE / LOGICSTAT/ PRAGATI / KAPPA / SOUTHERN ELECTRIC
15.0	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS/ BAJAJ/ CROMPTON
16.0	CABLE LUGS (HEAVY DUTY)	DOWELLS
17.0	CABLES	
a)	POWER CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT / FINOLEX/ POLYCAB/KEI
b)	CONTROL CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER / DELTON / FINOLEX / TORRENT / CCI / ICL / RADIANT / KEI.
c)	TRAILING CABLE	NICCO /UNIVERSAL/INCAB/ICL/KEI/



**MAIN VENDOR AND SUB VENDOR FOR
ELECTRIC HOIST
1X800 MW KOTHAGUDEM TPS**

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18.0	CABLE GLAND	COMMET / SIEMEN / SUNIL&CO.
19.0	PUSH BUTTONS	SIEMENS / L&T / BCH /SCHNIDER
20.0	LIMIT SWITCHES	SPEED-O-CONTROL / ELECTROMAG / JAI BALA JI
21	SELECTOR SWITCHES	KAYCEE/ SULZER
23	INDICATING LAMPS	TECKNIC / BCH / SIEMENS / STANDARD/ VAISHNO
24	MCB	MDS / INDO COPP / STANDARD
25	PANELS	OEM/BCH
26	DSL	SUSHEEL/STROMAG
27	TERMINAL BLOCKS	ELMEX/CONNECTWELL/WAGO (FOR CONTROL ONLY)
28	VVVF	YASAKAWA(L&T)/ABB/SIEMENS/SCHNIDER
29	CASTING	KOLHAPUR STEEL / GNAT FOUNDARY / KIRTI ALLOYS
30	Tools & tackles	Reputed make

Note : 1 All the trailing cables shall be sourced from only one sub-vendor from the list
2 No other make will be acceptable, until and unless specifically got approved by BHEL/Customer / Customer's consultant during detail engineering only. Acceptance/non acceptance of same shall not have any impact on manufacturing, delivery schedule and on cost of the Electric hoists/ CPB

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ANNEXURE-II

ANNEXURE-II A FOR MECHANICAL ITEMS

LIST OF MANDATORY SPARES

S.No.	Items	Quantity	Remarks
2.1	Screw Chiller		
2.1.1	Bearing for the compressor	1 Set	
2.1.2	Gaskets as applicable for Condenser & Chiller Heads	1 Set for each category	
2.2	Centrifugal Pump	5% of one Condenser	
2.2.1	Bearings for each pump and motor	2 Sets for each category	
2.2.2	Mechanical seal, wearing rings and lantern rings	1 Set for each category	
2.3	Cooling Tower		
2.3.1	Spray nozzles	10% of one tower	
2.3.2	Set of fills	10% of one tower	
2.3.3	Bearings for each fan and motor	2 sets	
2.4	Refrigerant & Oil		
2.4.1	Refrigerant gas in a non-returnable cylinder	15% of installed charge	
2.4.2	Empty cylinders of 68 Kg capacity to hold the charge of the highest capacity system	As required to suit the above	
2.4.3	Filter oil in sealed tins for the full set for 6 operations of cleaning	As required	
2.5	Air Handling Units		
2.5.1	Bearings for each AHU blower & motor	1 Set for each category	
2.5.2	V-Belts	2 Sets for each category	
2.5.3	Filters of each type	2 Sets for each category	
2.6	Centrifugal fans		
2.6.1	Bearings for fan & motor	2 Sets for each category	
2.6.2	V-belts	1 Set for each category	
2.6.3	Vibration Isolators	1 set	
2.7	Precision Air Conditioners		
2.7.1	Vibration Isolators	1 Set for each category	
2.7.2	Filters	1 set for each PAC unit	
2.7.3	Bearings	1 set for each rating of PAC unit (both for condenser & Indoor Unit)	
2.7.4	Condenser fan Impeller	1 set for each PAC unit	
2.7.5	Expansion valve	1 set for each rating of PAC unit	
2.7.6	Any other spare parts recommended by the Manufacturer	1 set for each rating of PAC unit	
2.8	Split Air Conditioners		
2.8.1	Fan-motor bearing for outdoor unit	1 set for each rating of SAC unit	
2.8.2	Vibration Isolators	1 set each for outdoor unit & Indoor unit for each SAC unit	
2.8.3	Filter	1 set for each SAC unit	
2.8.4	Expansion valve	1 set for each rating of SAC unit	
2.8.5	Any other spare parts recommended by the Manufacturer	As recommended by the Manufacturer	


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ANNEXURE-II B FOR C&I ITEMS

**C&I MANDATORY SPARES LIST FOR
AUXILIARY PACKAGE
FOR 1 X 800 MW KOTHAGUDEM**


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C&I MANDATORY SPARES FOR AC SYSTEM FOR 1 X 800 MW KOTHGUDEM		
A	Field Instruments	
1	Transmitters/ Gauges/Switches etc. along with relevant accessories	10% of total or at least two (whichever is higher) for each type along with accessories.
2	Temperature Element (RTD/Thermo-couple) with thermowell	10% of each type , range and immersion length . Minimum 5 nos.
3	Furnace Temperature Probe	Thermocouple 1 no.
B	Control Panel/Desk Mounted Items	
1	Back-up panel mounted devices (Selector switches/ Push buttons/ Indicators etc.)	5% of installed capacity
2	Lamps/ LEDs	100% of the total quantity
3	Blank Tiles	10% of installed capacity
4	MCBs	10% of each type & rating
5	Fuses/ Fuse holder	100% of each type & rating
C	Actuator	
1	Complete set of Actuator	1No. for each type and rating
2	Limit Switch	3 Nos each type and rating
3	Torque Switch	3 Nos each type and rating
4	Auxiliary Contact	1 no each type and rating
5	Motor	1 no each type and rating
6	Complete Seal kit	1Set for each type and rating
7	Complete O-Ring Set	1Set
8	Electronic Card	One(1) for each type/make
9	Feedback Assembly (4-20mA) for Inching type	One(1) for each type/make
D	UPS (For BOP systems)	
1.1	Fuse	3 (Three) times of total quantity of each type of fuses used in the system (for all BOP systems).
1.2	SCR	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.

1.3	Diode	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.
1.4	IGBT	2 (two) nos.
1.5	Electronic Module/ PCB	
1.5.1	Static Switch	1 (one) no. each type of ElectronicCard/ PCB/ modules used in the system
1.5.2	Inverter	1 (one) no. each type of ElectronicCard/ PCB/ modules used in the system
1.5.3	Static voltage Regulator	1 (one) no. each type of ElectronicCard/ PCB/ modules used in the system
1.5.4	Charger	1 (one) no. each type of ElectronicCard/ PCB/ modules used in the system
1.5.5	UPS of 2 KVA rating or below.	One Complete set.
1.5.6	Selector Switch	1 (one) no. each type
1.5.7	Digital Voltage/ Current Indicator (LCD type)	1 (one) no. each type
1.5.8	Indication Lamp- Complete assembly (Red/ Green colour)	1 (one) no. each type
1.5.9	Cooling Fan - 240 VAC supply	1 (one) no. each type
1.6	UPS Battery	
1.6.1	Battery Cell (Uncharged, Dry)	10% of total quantity of each BOP UPS.
1.6.2	Inter connecting cell strips	10 nos.
1.6.3	Rubber gloves	1 pair
1.6.4	Voltmeter for measuring cell voltage(Center zero type)	1 no.
1.6.5	Apron & Goggles	1 set
1.6.6	Cell lifting puller	1 no.
1.6.7	Insulated socket spanner with handle	1 no.
1.6.8	Terminal screw with bellaville washer	10% of total quantity used
1.6.9	Thermometer	1 no.
E	PLC/ Proprietary Control System	
1	Network cards, Communication Interface cards	5% for each type or but minimum 1 no.
2	I/O Cards (Each type)	5% for each type but minimum 1 nos.
3	Controller Cards	2 nos.
4	SER Cards	5% for each type or but minimum 1 no.

5	All other Electronic Modules	5% for each type but minimum 1 no.
6	Relays	10% of total quantity
7	Power Supply Modules & Power Packs for control system	5% for each type and range but minimum 1 no.
8	Network Items (Network switch/ LIU unit/ Transceiver/ FO patch cord etc.)	10% for each type or but minimum 1 no.
9	MCB (Miniature case circuit breaker)	10% for each type or but minimum 1 no.
10	Fuses	200% each type and rating
11	Racks for housing I/O & Processor Modules	1(One) no. each type used in the system
12	Prefab interconnecting cables with connectors	10% of total nos. used in the system or minimum 4(four) nos. whichever is more for each type.
13	Network communication cable with end connectors	10% but minimum 1
14	I/O bus cables with connectors for remote I/O units	1 no. of each type & length
15	Fibre optic cable Converter / Deconverter	1 no.
16	Cooling Fans	10% but minimum 1
17	Loose Connectors	5 nos. of each type
18	Colour TFT Monitor	1 no. complete set
19	Hard Disk Drive for the work Station	1 no. complete set
20	Key board , mouse / trackball with connecting cables and plugs	1 no. each type.
21	Printers Catriges	2 nos. of each type
22	SMPS for printers	1 no. of each type/ rating
23	SVGA cards for printers	1 no. of each type
24	Key Board & Cursor control device	1 no. of each type
25	Complete Set of Operators Work Station	1no. complete set
26	Terminal Block	10% of total nos. used in the system for each type and rating.
27	Read-Write CD/DVD	10% but minimum 1
28	Blank CD/DVD	50 (fifty) nos.


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ANNEXURE-II C FOR ELECTRICAL ITEMS

Mandatory Spares for Electrical

S.No.	Items	Qty.	Remarks
1	Electrical Spares for panels		
1.1	Control Supply Transformer	2 Nos. of each type and rating	
1.2	Contractor	2 Nos. of each type and rating	
1.3	Coils for contractor & aux. contractor	5 Nos. for each contractor	
1.4	Main & Aux. Contacts sets for contractor and Aux. Contractor	5 Sets. For each contractor	
1.5	Air Break Switch	1 No. for each rating	
1.6	Control, Isolating and selector switches	5% of each type and rating	
1.7	MCB/ MCCB	10% of installed quantity	
1.8	Circuit Breaker	1 No. for each rating	
1.9	Indicating Lamps	10% of installed quantity	
1.10	Indicating Lamps cover of different colour and holders	5% of installed quantity	
1.11	Push Buttons of various colours	10 nos. of each type and colour	
1.12	Terminal Blocks	5% of installed quantity	
2	Electrical Spares for Motors		
2.1	Terminal plates	10 Nos. each for small motors up to 30KW and 4 Nos. each for motors above 30KW	
2.2	Heaters	1 Set for each motor of rating above 30KW	
2.3	Greasing arrangements	4 sets for each type of motors	
2.4	Motors below 0.75 KW	10% of the installed quantity or minimum 1 no. whichever is higher	
2.5	Bearings (DE & NDE)	4 sets of each type and rating	
3	Motor		
3.1	HT Motor (other than BFP Motor)		
3.1.1	Driving End Bearing	1 no. (or 1 Set as applicable)for each type and rating of Motor	
3.1.2	Non-Driving End Bearing	1 no. (or 1 Set as applicable)for each type and rating of Motor	
3.1.3	Cooling Fan Internal & External	1 no. for each type and rating of Motor	
3.1.4	Bearing temperature Gauge Driving & Non-Driving End	1 no. for each type and rating of Motor	
3.1.5	Phase-Segregated Terminal Box	1 no. for each type and rating of Motor	
3.1.6	Neutral End terminal Bushing with Fasteners	1 no. for each type and rating of Motor	
3.1.7	RTD for Bearing Temperature	1 no. for each type and rating of Motor	
3.1.8	Motor Space Heater	1 no. for each type and rating of Motor	
3.1.9	Complete set of Coupling	1 Set for each Application	
4	415 Volt Motor (above 30KW Rating upto 200KW)		
4.1	End Shield Cover Driving & Non-Driving End	1 no. for each type and rating of Motor	
4.2	Driving End & Non-Driving End Bearing	1 no. for each type and rating of Motor	
4.3	Cooling Fan	1 no. for each type and rating of Motor	
4.4	Motors Space Heater	1 no. for each type and rating of Motor	
4.5	Motor Terminal Block	1 no. for each type and rating of Motor	
4.6	Complete Set of Coupling	1 Set for each Application	
5	415 Volt Motor (Upto 30KW Rating)		
5.1	Driving End & Non-Driving End Bearing	3 Set for each type and rating of Motor	
5.2	Cooling Fan	2 no. for each type and rating of Motor	
5.3	Motor Terminal Block	5 no. for each type and rating of Motor	
5.4	Complete Set of Coupling	1 Set for each Application	
6	D C Motors		
6.1	Carbon brushes	10 sets each type	
6.2	Brush assemblies	2 sets each type	
6.3	Terminal blocks	2 sets each type	
6.4	Heaters	2 sets each type	
6.5	Pulleys	2 sets each type	
6.6	Bearings (DE and NDE) for each type and rating of motor	4 sets	


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MANDATORY SPARE FOR
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1X800 MW KOTHAGUDEM TPS

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ANNEXURE-II D FOR MATERIAL HANDLING ITEMS

MANDATORY SPARES: (As Applicable)

As per list below.

1.11	HOISTS (for each type and rating, hoists)	
1.11.1	Bearings for long travel wheels	2 sets
1.11.2	Bearings for gear boxes for each type of hoist	2 sets
1.11.3	Break liners for all the brakes	100% of total population of each type & size
1.11.4	Oil seals	100% of total population of each type, size rating
1.11.5	Brake springs for all brakes	-do-
1.11.6	Wire ropes for hooks	100% installed on each crane and hoist
1.11.7	Solenoid coils for brakes	2 sets
1.11.8	Overload relay for motors	2 Nos.
1.11.9	Limit switches for hoists and travel mechanisms	2 sets
1.11.10	Spare motors for hoists	2 Nos.
1.11.11	Long travel machinery	
	i. Gear wheel	1 set
	ii. Internal clip	2 Nos.
	iii. Pinion	1 No.
2	Electrical Items	
2.1	Trailing Cable	One set of full length of each size/type of cables as used for each type of Electrical Hoist
2.2	415 Volt Motor (Up to 30KW Rating)	
a	Driving End & Non-Driving End Bearing	3Set for each type and rating of Motor
b	Cooling Fan	2No. for each type and rating of Motor
c	Motor Terminal Block	5Nos. for each type and rating of Motor
d	Complete Set of Coupling	1Set for each Application
2.3	Control Panel/ Desk Mounted Items	
2.3.1	Push Button	
2.3.1.1	Complete assembly	5 nos. of each color
2.3.1.2	Contact Element (1NO-1NC) Blocks	20Nos.
2.3.2	Selector Switch	10 Nos. of each type and rating
2.3.3	Meter (Analog or digital)	
2.3.3.1	Ammeter	10% for each type & range or minimum 1 no. whichever is more
2.3.3.2	Voltmeter	10% for each type & range or minimum 1 no. whichever is more
2.3.3.3	Frequency	10% for each type & range or minimum 1 no. whichever is more
2.3.3.4	MW	10% for each type & range or minimum 1 no. whichever is more
2.3.3.5	MVAR	10% for each type & range or minimum 1 no. whichever is more
2.3.3.6	Power Factor	10% for each type & range or minimum 1 no. whichever is more
2.3.3.7	Synchroscope	10% for each type & range or minimum 1 no. whichever is more
2.3.4	Indicating Lamps complete	10 Nos. of each colour & type



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	assembly	
2.3.5	Mimic Lamps	10 Nos. of each colour & type
2.3.6	MCB	2 Nos. for each type and rating
2.3.7	Door limit Switch	2 Nos.
2.3.8	Annunciation System	
2.3.8.1	Lamp Box with Facia & Lamps (LED Type)	25 Nos.
2.3.8.2	Hooter	1 No.
2.3.8.3	Each Type of PCB (for non-PLC driven system)	1 No.

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ANNEXURE-III

LIST OF TOOLS & TACKLES

FLAT D WRENCH - 6 MM TO 32 MM (12 Pcs)	SET	1
BOX WRENCHES - 6 MM TO 22 MM (14 Pcs)	SET	1
RING SPANNER - 6 MM TO 32 MM (12 Pcs)	SET	1
ALLEN KEYS - 2 MM TO 10 MM	SET	1
CRESCENT SCREW SPANNER	NO.	1
SCREW DRIVER	NO.	1
OFFSET SCREW DRIVER	NO.	1
INSULATED PLIER	NO.	1
TORCH LIGHT FOR 2 CELL	NO.	1
HAMMER 1 LB	NO.	1
OIL CAN	NO.	1
POCKET THERMOMETER - 0 TO 50 DEG. C)	NO.	1
INSULATION TAPE ROLL	NO.	1
STEEL FOOT RULE - 12"	NO.	1
FEELER GAUGE 9 BLADES	NO.	1
PIPE WRENCH	NO.	1
FLARE NUT (1/4")	NOS.	6
FLARING TOOL	NO.	1
TUBE CUTTER	NO.	1
GAS CHARGING PIPE	NO.	1
NITROGEN CHARGING ADAPTER	NO.	1
FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 0 - 300 MM PSI	NO.	1
FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 30 - 150 MM PSI	NO.	1
PSYCHRO METER	NO.	1
LOCK WITH KEY FOR TOOL BOX	NO.	1
RATCHET 1/4"	NO.	1
MS TOOL BOX	NO.	1


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TOOLS & TACKLES FOR
ELECTRIC HOIST
1X800 MW KOTHAGUDEM TPS

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Maintenance Tools and Tackles

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied for each EH/CPB. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox. The items supplied shall be of the best quality, specially protected against rusting. The following shall be provided as minimum requirement:

S-No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set
2	Complete set of screwdrivers (Indicate the sizes)	1 Set
3.	Adjustable Spanner	1 No.
4.	Insulated plier	1 No.
5.	Grease gun	1 No.
6.	Oil gun	1 No.
7.	Line tester	1 No.
8.	Wrench spanner	1 No.
9.	Hand Lamp.	1 No.

Note: - Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same to be included in this list.


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ANNEXURE-IV

TREATED WATER QUALITY

(DESIGN ANALYSIS OF CLARIFIED WATER)

[After addition of 50 ppm Alum, 20 ppm Lime ,1 ppm Polyelectrolyte and
5 ppm Chlorine on 100% purity basis)]

DESIGN ANALYSIS OF CLARIFIED WATER:

CONSTITUENTS	As	CONTENT
Calcium	CaCO ₃	128.9 ppm
Magnesium	CaCO ₃	53.52 ppm
Sodium	CaCO ₃	73.44 ppm
Potassium	CaCO ₃	1.02 ppm
Iron in Soln.	Fe	0.1 ppm
Hydrogen (FMA)	CaCO ₃	- ppm
TOTAL CATIONS (except iron)	CaCO ₃	256.88 ppm
Bicarbonate	CaCO ₃	143.4 ppm
Carbonate	CaCO ₃	0.53 ppm
Hydroxide	CaCO ₃	0.02 ppm
Sulphate	CaCO ₃	59.85 ppm
Chloride	CaCO ₃	50.82 ppm
Nitrate	CaCO ₃	1.21 ppm
Phosphate	CaCO ₃	- ppm
Fluoride	CaCO ₃	1.05 ppm
TOTAL ANIONS	CaCO ₃	256.88 ppm
Reactive Silica	SiO ₂	10 ppm
Total Suspended Solid	CaCO ₃	15 ppm (overload condition)
Conductivity at 25 deg C		450 Microsiemens/cm (max)
pH value at 25 ⁰ C	-	7.62
Turbidity		Not to exceed 15 NTU (max)


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	TITLE ANNEXURE-V AIR-CONDITIONING SYSTEM INSPECTION AND TESTING	SPECIFICATION NO. PE-TS-410-553-A001	
		VOLUME	
		SECTION - E	
		REV 00	DATE 11.03.2015
		SHEET 1	OF 3
1.00.00	INSPECTION AND TESTING		
1.01.00	Inspection and Tests during Manufacture.		
1.01.01	The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.		
1.01.02	The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.		
1.01.03	Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.		
1.01.04	Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results. The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture. The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.		
1.01.05	Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.		
1.01.06	All the individual and assembled rotating parts shall be statically and dynamically balanced in the works. Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.		
1.01.07	All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory Regulations shall be certified by a Competent Authority under the regulations in the specified format.		

	TITLE	SPECIFICATION NO. PE-TS-410-553-A001	
		VOLUME	
		SECTION - E	
		REV 00	DATE 11.03.2015
		SHEET 2	OF 3
1.01.08	All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.		
1.01.09	All necessary non-destructive examinations shall be performed to meet the applicable code requirements.		
1.01.10	All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnafux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major but welding joints shall be radiographed unless otherwise stipulated. Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.		
1.02.00	Performance Tests at Site		
1.02.01	The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.		
1.02.02	The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.		
1.02.03	The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to test on completion and commissioning of the complete system/equipment.		
1.03.00	For details of specific tests required on individual equipment refer to respective section of this specification. All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required		
1.04.00	AIR CONDITIONING SYSTEM		
	AT SHOP		
1.04.01	Power consumption of chilled & condenser water pumps, chilling units, condensing units, air handling units, package air conditioners & cooling towers of AC system at rated duty point with respective job motors.		



TITLE

AIR-CONDITIONING SYSTEM INSPECTION AND TESTING

SPECIFICATION NO. PE-TS-410-553-A001

VOLUME

SECTION - E

REV 00 DATE 11.03.2015

SHEET 3 OF 3

1.04.02 Capacity & head of all the fans of AC system of all the areas.

AT SITE

1.04.03 AC Plant capacity of each area and guaranteed room condition during summer and monsoon for all the Air conditioned area along with the power consumption of air conditioning units.

1.04.04 Parallel operation, vibration & noise level of all rotating equipment.


 Vivek KUMAR
 SA Khan Praveen Kishore

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

Legend:		1. BHEL			2. Vendor			3. Sub-Vendor		
QP No	CQS/SQP/31 Rev	Signature			Date					
					Name					
Page No		1 of 1			Party					
					Customer/Consultant		Bhel		Vendor 	




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ANNEXURE-VII

MASTER DRAWING LIST

S.NO.	BHEL DRG NO	DRG TITLE	SCHEDULE(WEEK AFTER PLACEMENT OF LOI TO VENDOR)
1	PE-V0-410-553-A001	INSPECTION CATEGORY PLAN	2
2	PE-V0-410-553-A002	QUALITY PLAN OF SCREW CHILLERS	8
3	PE-V0-410-553-A003	QUALITY PLAN OF CENTRIFUGAL PUMPS	8
4	PE-V0-410-553-A004	QUALITY PLAN OF COOLING TOWER	10
5	PE-V0-410-553-A005	QUALITY PLAN OF AHU	11
6	PE-V0-410-553-A006	QUALITY PLAN OF PLC	11
7	PE-V0-410-553-A007	QUALITY PLAN OF MOTOR	11
8	PE-V0-410-553-A101	HEAT LOAD CALC FOR MAIN CONTROL ROOM AREAS IN TG BLDG, ESP CONTROL ROOM BUILDING ADMINISTRATIVE AND SERVICE BUILDING.	3
9	PE-V0-410-553-A102	PRESSURE DROP CALC FOR CHILLED WATER PIPING & CONDENSER WATER PIPING	8
10	PE-V0-410-553-A103	CONTROL & OPERATION PHILOSOPHY OF AC SYSTEM	10
11	PE-V0-410-553-A201	DATA SHEET AND GA FOR SCREW CHILLER	8
12	PE-V0-410-553-A202	DATA SHEET AND GA FOR PAC & WATER COOLED PRECISION AC	8
13	PE-V0-410-553-A203	DATA SHEET AND GA FOR AHUs AND FCUs	8
14	PE-V0-410-553-A204	DATA SHEET AND GA FOR CONDENSER WATER AND CHILLED WATER PUMPS	10
15	PE-V0-410-553-A205	DATA SHEET AND GA FOR COOLING TOWER	10
16	PE-V0-410-553-A206	DATA SHEET AND G.A. FOR PRE AND FINE AND FILTER ALONGWITH FIXING DETAILS.	11
17	PE-V0-410-553-A207	DATA SHEET AND GA FOR FIRE DAMPER ALONGWITH FIXING DETAILS.	8
18	PE-V0-410-553-A208	DATA SHEET AND GA FOR FRESH AIR FANS	8
19	PE-V0-410-553-A209	DATA SHEET AND GA DRAWINGS FOR VLAVES (BALANCING, GATE, NRV, B/F , MOTORISED B/F, Y-STRAINER AND OTHER VALVES AS APPLICABLE)	8
20	PE-V0-410-553-A210	DATA SHEET AND GA FOR 3 WAY MOTORISED VALVE	9
21	PE-V0-410-553-A211	DATA SHEET AND GA FOR HEATER PACKAGE	8
22	PE-V0-410-553-A212	DATA SHEET AND GA FOR PAN HUMIDIFIER	7
23	PE-V0-410-553-A213	DATA SHEET FOR INSTRUMENTS (TEMPERATURE GAUGE, PRESSURE GAUGE, PRESSURE SWITCH, SENSORS - TEMPERATURE & HUMIDITY, LEVEL GAUGE, LEVEL SWITCH & DIFFERENTIAL PRESSURE SWITCH AND OTHER APPLICABLE INSTRUMENTS).DATA SHEET AND GA FOR WATER SOFTENING PLANT.	7
24	PE-V0-410-553-A214	DATA SHEET OF INSULATION FOR DUCT, PIPE AND ACCOUSTIC LINING ALONG WITH TYPICAL DETAIL FOR DUCT, PIPE AND ACCOUSTIC INSULATION	10
25	PE-V0-410-553-A215	DATA SHEET FOR SPLIT AC	12
26	PE-V0-410-553-A216	DATA SHEET FOR PIPES	12
27	PE-V0-410-553-A217	DATA SHEET FOR GI SHEET	5
28	PE-V0-410-553-A218	DATA SHEET AND GA DRAWING FOR GRILLS / DIFFUSERS / DAMPERS ETC	5
29	PE-V0-410-553-A219	DATA SHEET AND GA DRAWING FOR SOFT WATER, EXPANSION TANK	8
30	PE-V0-410-553-A220	TDS AND GA OF MOTOR (PUMP, COOLING TOWER, AHU)	5
31	PE-V0-410-553-A221	COMPLETE PLC DATA SHEET & GA, PANEL WIRING DIAGRAM, UPS LAYOUT, UPS CALCULATION, BATTERY LAYOUT ETC.	11
32	PE-V0-410-553-A501	P&I DIAGRAM FOR AC SYSTEM	2
33	PE-V0-410-553-A502	AC PLANT ROOM LAYOUT, COOLING TOWER AREA LAYOUT WITH EQPT FOUNDATION DETAILS	4
34	PE-V0-410-553-A503	AC DUCT LAYOUT AND AHU ROOM DRAWING FOR CONTROL ROOM AREAS AT 17M ALONG WITH AHU ROOM LAYOUT WITH FOUNDATION DETAILS	4
35	PE-V0-410-553-A504	AC DUCT & AHU ROOM LAYOUT WITH FOUNDATION DETAIL FOR UPS BATTERY CHARGER ROOM AT 8.5M AND SWAS ROOM AT 0 M	4
36	PE-V0-410-553-A505	CHILLED & CONDENSER WATER PIPING LAYOUT INSIDE AC PLANT, COOLING TOWER, AHU ROOMS IN ALL BUILDING AND INTERCONNECTING CHILLED WATER PIPE FROM PLANT ROOM TO ALL AHU ROOM.	4
37	PE-V0-410-553-A506	AC DUCTING & DIFFUSER LAYOUT FOR ESP CONTROL ROOM ALONG WITH AHU ROOM LAYOUT WITH FOUNDATION DETAIL.	4
38	PE-V0-410-553-A507	AC DUCTING & DIFFUSER LAYOUT FOR SERVICE BUILDING ALONG WITH AHU ROOM LAYOUT WITH FOUNDATION DETAIL.	4
39	PE-V0-410-553-A508	AC DUCTING & DIFFUSER LAYOUT FOR ADMINISTRATIVE BUILDING ALONG WITH AHU ROOM LAYOUT WITH FOUNDATION DETAIL.	4
40	PE-V0-410-553-A509	TYPICAL Details DUCT: FABRICATION, SUPPORT AND ERECTION. INSULATION: DUCTING, PIPING, EQUIPMENTS AND ACOUSTIC LINING. PIPING: FABRICATION, SUPPORT AND ERECTION	7
41	PE-V0-410-553-A510	SPLIT AC SCHEDULE	10
42	PE-V0-410-553-A901	DEMONSTRATION TEST PROCEDURE	10
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Format for Operation & Maintenance Manual

Project name:

Project number:

Package Name:

Sl.no. & Sections	Description	Yes	No	Not Applicable	Remarks
1.	Cover page				
1.1	Project Name				
1.2	Customer Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX email address				
1.5	Name and sign of prepared by , checked by & approved by				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	Transportation and handling at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the				


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	logic, drawings etc. to be provided.				
5.2	Start up and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts				

	list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				

Dealing Engineer

Key Resource Person

Section Head


 Vivek KUMAR

 SA Khan

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL


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1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,


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preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.


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10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.


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4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles


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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moist rain
74.	Alum bricks	C	Damage to packing	Prevent moist rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

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5. CONCLUSI ON

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.


VIVEK KUMAR

SA Khan

Praveen Kishore

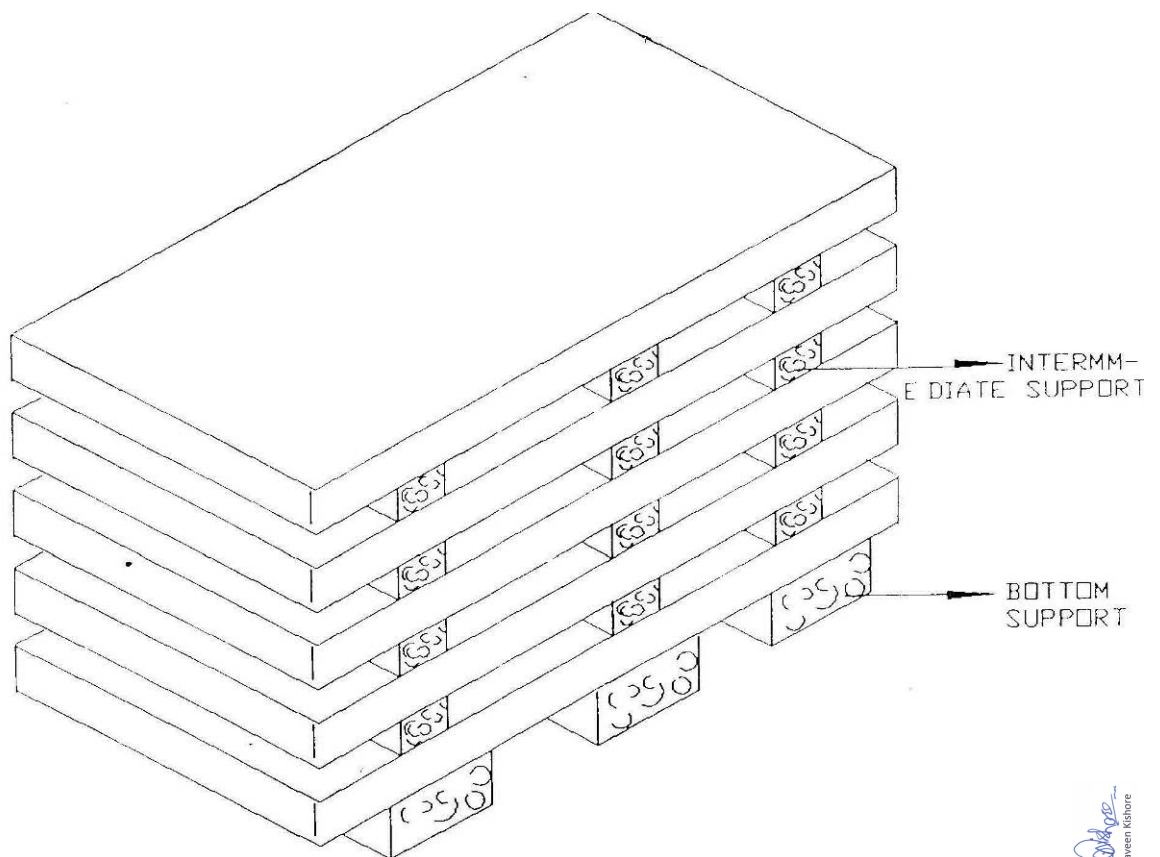


Figure – 1 – PLATE STACKING ARRANGEMENT

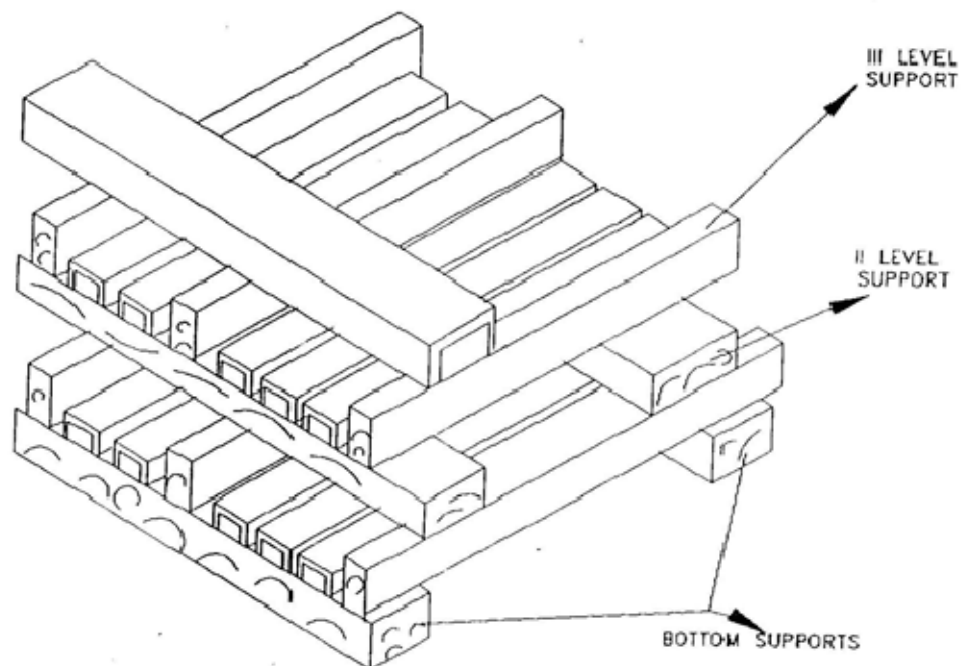


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

	TITLE: TECHNICAL SPECIFICATION FOR AIR-CONDITIONING SYSTEM 1X800 MW TSGENCO KOTHAGUDEM TPS ANNEXURE-X	SPEC NO: PE-TS-410-553-A001
		VOLUME: II-B

TABLE-3

DRAWING/DOCUMENT DISTRIBUTION SCHEDULE															
S no.	Description	TSGENCO								DCPL, KOLKATA			Equipment Vendor	PEM	BHEL site
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/TPC-I, Hyd	CE/O&M/KTPS	SE/Civil KTPS	SE/E&M/KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS			
A	Letter Of Intent or Contract Documents	1	1	1	S	1	2	2	1	1	1	1	2	1	1
B	Vendor Drawings														
1	Preliminary	1	1	1	2	1	1	2	2	12	1	-	S	4+S	-
2	Return preliminary with comments	-	-	1	2	1	1	1	1	S	1	-	1	4+S	-
3	Final and any revision thereof														
	a. Civil	1	1	6+1T	1	1	6+1T	1	-	2+1T	1	1	S	4+S	-
	b. E&M	1	1	1	6+1T	1	1	6+1T	1	2+1T	1	1	S	4+S	-
C.	Design Drawings														
1	Preliminary														
	a. Civil	1	1	2	1	1	2	1	1	4	1	1	S	4+S	-
	b. E&M	1	1	1	2	1	1	2	1	4	1	1	S	4+S	-
2	Released for construction														
	a. Civil	1	1	2	1	1	6	1	1	1	1	2	S	1+S	4+S
	b. E&M	1	1	1	1	2	1	6	1	1	1	2	S	1+S	4+S
3	Return marked 'As built'														
	a. Civil	-	-	1	-	-	1	-	-	1	1	S	1	1+S	4+S
	b. E&M	-	-	-	1	-	-	1	1	1	1	S	1	1+S	4+S
4	As built drawings														
	a. Civil	-	-	1+1T	-	2+1T	5+1T	-	1	1+1T	-	1	S	1+S	4+S
	b. E&M	-	-	1	2+1T	2+1T	-	5+1T	1+1T	1+1T	-	1	S	1+S	4+S
D	Progress Report Monthly														
1	Equipment vendor	1	1	1	2	1	1	2	1	1	1	1	S	S	1+S
2	M/s DCPL, Kolkata	1	1	2	2	1	1	2	1	S	1	1	Nil	-	-
E	Test & Inspection Reports														
1	Equipment manufacturer														
	a. Civil	1	1	1	2	1	1	1	-	11	1	1	S	S	S
	b. E&M	1	1	-	2	1	-	1	1	11	1	1	S	S	S
2	M/s DCPL, Kolkata	1	1	-	2	1	-	1	1	S	-	1	-	S	S
F	Instruction Manuals/Data Books														
1	Equipment manufacturer														
	a. Civil	1	1	1+1T	1	1	6+1T	1	1	2+1T	1	1	S	1+S	4+S
	b. E&M	1	1	-	3+1T	1	-	6+1T	2	3+1T	1	1	S	1+S	4+S
2	M/s DCPL, Kolkata	1	1	-	10+1T	1	-	15+1T	-	S	1	1	Nil		
G	M/s DCPL, Kolkata Criteria	1	1	1	8+1T	1	1	2	1	1	1	1	S	1+S	4+S
H	Design Calculations	1	1	1	8+1T	1	1	2	1	1	1	1	S	1+S	4+S
I	Final consulting Engineering Report	1	1	1	10	1	1	2	1	S	1	1	Nil	S	1+S

S – Source, T – Transparency & Soft Copy on CD.
Note: Editable EXcell, Word and Autocad copy of applicable document shall be submitted by bidder/vendor whenever required by BHEL/Customer for review.



TITLE

STANDARD TECHNICAL SPECIFICATIONS
1X800 MW KOTHAGUDEM
AIR CONDITIONING SYSTEM

SPECIFICATION NO. PE-TS-410-553-A001

VOLUME II B

SECTION D

REV 00

DATE APRIL 2015

SECTION-D

STANDARD TECHNICAL SPECIFICATIONS

Praveen Kishore
SA Khan Praveen Kishore
Vivek Kumar
VIVEK KUMAR



STANDARD TECHNICAL SPECIFICATION
CENTRAL AIR-CONDITIONING PLANT

SPECIFICATION NO.PES-553-01

VOLUME II B

SECTION D

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SHEET 1 OF 5

SECTION-D
CENTRAL AIR CONDITIONING PLANT


VIVEK KUMAR SA Khan Praveen Kishore



TECHNICAL SPECIFICATION
CENTRAL AIR-CONDITIONING

SPECIFICATION NO.PES-553-01
VOLUME II B
SECTION D
REV. 02 DATE: 17.09.2012
SHEET 2 OF 5

1. GENERAL

1.1 This specification covers the design, manufacture, testing at Manufacturer's works, delivery to site, handling at site, installation, commissioning and carrying out acceptance tests and final painting at site of various equipment of the central air conditioning plant, as specified hereinafter.

2. CODES & STANDARDS

2.1 The design, manufacture and performance of air conditioning equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment are to be installed. The equipment shall also conform to the latest applicable Indian/British/American standards. Nothing in this specification shall be construed to relieve the tenderer of this responsibility. In particular the equipment shall conform to the latest editions of the following standards.

2.1.1	IS-660	:	Safety code for Mechanical Refrigeration.
2.1.2	ARI 520-90	:	Standard for Positive Displacement Refrigerant compressors and condensing units.
2.1.3	IS-5111	:	Code of Practice of Measurement for Testing Refrigeration compressors.
2.1.4	ASHRAE/23-93	:	Method of Testing for Rating Positive Displacement Refrigerant compressors and condensing units.
2.1.5	ARI-450	:	Standard for water-cooled Refrigerant condensers, Remote Type.
2.1.6	ASME	:	Unfired pressure Vessels Code. (Section VIII)
2.1.7	IS-2825	:	-do-
2.1.8	IS-4503	:	Shell and tube type heat exchangers.
2.1.9	ASHRAE/22-92	:	Method of Testing for rating of Water Cooled refrigerant condensers.
2.1.10	IS-659	:	Safety code for Air conditioning.
2.1.11	IS-2379	:	Color Code for Identification of pipe lines.
2.1.12	TEMA	:	Standards of Tubular Exchanger manufacturers Association.
2.1.13	IS-1239 (Part-I)	:	Seamless steel tubes (Up to & including 168.2 mm OD.).
2.1.14	IS-3589	:	For piping above 168.2mm to 2032mm Outside Diameter.
2.1.15	IS-778	:	Valves up to 50 MM.
2.1.16	IS-780	:	Valves 50 MM to 300 MM.
2.1.17	ASHRAE 24	:	Method of Testing for Rating liquid coolers.
2.1.18	ARI-480	:	Standard for refrigerant cooled liquid coolers-Remote type.


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TECHNICAL SPECIFICATION
CENTRAL AIR-CONDITIONING

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3. DESIGN & CONSTRUCTION REQUIREMENTS

- 3.1 The components of Central air conditioning plant comprising compressor, chiller refrigerant piping, valves and fittings etc. Shall be as given in Data sheet A. The type of all accessories, controls and instrumentation shall also be as indicated in data sheet A.
- 3.2 The various equipments supplied under this specification shall be fully compatible with each other & capable of operating as fully balanced integrated system to deliver the specified output under design conditions.

4. TESTING AND INSPECTION

(Refer standard quality plan)

- 4.1 Hydrostatic, Volumetric and refrigerant leak tests etc. shall be carried out at manufacturers works before dispatch of equipment in accordance with the applicable codes and standards.

Following minimum tests amongst others shall be conducted.

- 4.1.1 Material analysis, testing and identification (Data sheet/ Drg. Shall clearly indicate the specification, grade, class and Heat treatment condition of material for which TC will be furnished)
- 4.1.2 Hydrostatic pressure test of all pressure parts.(Testing pressure shall be clearly indicated for each component/ subassembly/ assembly)
- 4.1.3 Static and Dynamic balancing test of rotating parts at rated and over speed and to determine vibration & noise level.(Grade of balancing, type- whether dynamic or single plane balancing for components/ subassembly/ assembly shall be clearly indicated in data sheet/ approved drg.. Permissible vibration (velocity and displacement –peak to peak and noise level in dB(A) to be indicated in Data Sheet/Approved Drg.)
- 4.1.4 Radiography & magna-flux examination of materials & welds.(Components to be subjected to NDT with applicable, procedures and acceptance norms to be clearly indicated in Data sheet/ approved drg. If in a component only certain areas are to be subjected to NDT same shall be clearly brought out else it will be understood that the entire component is subject to NDT)
- 4.1.5 Ultrasonic test of castings & forgings.(Procedure and acceptance norms with areas subject to NDT to be clearly indicated in Quality Plan).
- 4.1.6 Performance test including determination of capacity, efficiency & characteristics etc.(Applicable standard, Acceptance norms, Procedure for test (if not covered in applicable standard),performance characteristics with applicable tolerances and drive to be used during shop test to be clearly indicated in Quality Plan). Performance data to be indicated in Approved Drg./ Data Sheet)
- 4.1.7 Functional checks and adjustments of controls & instrumentation. (Functional checks required to be clearly indicated with extent of check and applicable standard in approved check list / Quality plan. Class of instruments / tolerances and performance data to be incorporated in Approved Data Sheet / Drg.)
- 4.1.8 Checking of working clearances.(desired working clearances to be indicated in approved Drg.)
- 4.1.9 Examination after selective opening up after testing.(basis/ reasons for selective opening up, areas to be examined and parameters to be checked to be brought out in Quality Plan)



TECHNICAL SPECIFICATION
CENTRAL AIR-CONDITIONING

SPECIFICATION NO.PES-553-01
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4.2

TESTS AT SITE

Tests to prove guaranteed performance of the air conditioning plant, shall also be carried out at site after proper installation. The site test shall include performance testing (as per FQP) of equipment for 72 continuous hours each in all three seasons i.e. Summer, Winter and Monsoon. Unless specified elsewhere. All instruments, tools etc. as may be required to carry out site tests shall be arranged by the tenderer.

5.

PERFORMANCE GUARANTEE

5.1

Each equipment of air conditioning system shall be guaranteed for its rated capacity under the specified site conditions.

5.2

If the shop/site performance tests indicate failure of equipment to meet specified requirement, it would be tenderer's responsibility to carry out required alterations at no extra cost to purchaser. Tests shall be repeated after carrying out the modifications to demonstrate the performance.

5.2

The air conditioning plant before being taken over by purchaser shall be subjected to running test for a minimum period of one week during which all readings shall be recorded. Any deficiencies noted during this period, shall be rectified by the tenderer /at no extra cost to purchaser. These running tests shall be in addition to the seasonal performance test specified under clause 4.2. The inside design conditions shall be guaranteed throughout the year.


VIVEK KUMAR
SA Khan Praveen Kishore



TECHNICAL SPECIFICATION
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6. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

- 6.1 Final version of all drawings & data submitted with the along with technical schedules enclosed in Volume III.
- 6.2 Drawings including equipment layout, foundation & loading details etc. for civil works for the entire plant. These drawings must cover sufficient details so that design of civil works can be completed.
- 6.3 Inspection, operation & Maintenance Manuals.
- 6.4 Manuals for method of testing & calibration of all instruments.
- 6.5 Equipment description giving complete design calculations, basis of design, selection criteria etc.
- 6.6 Schematic piping diagrams.
- 6.7 Layout of piping.
- 6.8 Electrical drawings.
- 6.9 Test Certificates.
- 6.10 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

Praveen Kishore
SA Khan
Praveen Kishore
Vivek Kumar
VIVEK KUMAR



TITLE

CENTRAL AIR-CONDITIONING PLANT**DATA SHEET - A**

SPECIFICATION NO. PE-TS-410-553-A001.

VOLUME II-B

SECTION D

REV 00

DATE: APRIL 2015

SHEET 1 OF 4

DESCRIPTION**DATA****1. GENERAL**

1.1	Type of AC plant	: Chilled Water Type.
1.2	Plant configuration/capacity.	: Refer to Section-C of Specific Technical Requirements.
1.3	Location of AC plant rooms	: As per Tender drawings.
1.4	Type of lifting facility provided.	: Chain Pulley block with monorail (by BHEL)
1.5	Electrical work scope: -	
	i) MCC for AC plant	: By Others
	ii) Power cables / Control cables.	: By Others
	iii) Drives	: By Bidder.
	iv) Whether separate alarm/annunciation Panel/control panels required	: Yes (By bidder), Refer to Section-C of Specific Technical Requirements.
	v) Termination of cabling & earthing at Equipment end.	: By Bidder for bidder supplied equipment.

2. REFRIGERATION COMPRESSOR

2.1.	Type	: SCREW CHILLE
2.2.	Nos. (working + standby)	: Refer to Section-C of Specific Technical Requirements.
2.3.	Type of capacity control	: Automatic.
2.4.	Type of drive	: Direct driven.
2.5.	Restart after tripping	: Manual.
2.6.	Type of start	: As per manufacturing standard.
2.7.	Shaft Seal	: Mechanical shaft seal.
2.8.	Purge Recovery unit	: As per manufacturing standard.
2.9.	Type of lubrication	: As per manufacturing standard.
2.10.	Refrigerant used	: Environment friendly HCFC, (CFC is not acceptable)

WVEK KUMAR
SA Khan Praveen Kishore



TITLE

CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

SPECIFICATION NO. PE-TS-410-553-A001.

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3. DESIGN REQUIREMENTS

- 3.1. Minimum capacity at Design conditions : Refer to Section-C of Specific Technical Requirements.
- 3.2. Capacity control : Microprocessor based Control Panel sheet metal panel, located on each Compressor/chiller unit including protection devices
- 3.3. Vibration isolator : Neoprene rubber pads/Equivalent approved to suit chiller package.
- 3.4. Type of foundation : Floating / As per manufacturing standard

4.0 CONDENSER

- 4.1 Type : Horizontal shell & tube type water-cooled
- 4.2 Number required : One no. for each machine.
- 4.3 Design requirements
- 4.3.1 Fluid : Refrigerant (Shell side) Water (tube side)
- 4.3.2 Cooling Water Quantity : To suit requirement.
- 4.3.3 Capacity of condensers : To match compressor & to provide at least 2°C sub cooling.
- 4.3.4 Cooling water inlet temp. : Refer to Section-C of Specific Technical Requirements.
- 4.3.5 Leaving Water Differential. : Refer to Section-C of Specific Technical Requirements.
- 4.3.6 Max. flow velocity through tubes. : 2.5 m/sec.
- 4.3.7 Design fouling factor : 0.0002 (MKS Unit)
- 4.3.8 Maximum pressure drop. : 0.6 Kg/cm² (g)
- 4.3.9 Tube wall Thickness : Not less than 18 SWG
- 4.4 Materials of construction
- i/ Shell : M.S. Plate fusion welded.
- ii/ Tube : Integrally bonded Seamless copper

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iii/ Head ends : Cast Iron.

iv/ Tube sheet material : Steel

v/ Baffle plate : Steel.

4.5 Accessories required

i/ Purge & drain connections with valves. : Yes

ii/ Relief valves : Yes

iii/ Liquid line shut off valve. : Yes

iv/ Isolating valves on water side. : Yes

v/ Flow switch : Yes (interlocked with control of individual refrigeration system)

vi/ Pressure/temperature gauges at inlet/outlet : Yes

vii/ Descaling tee : Yes

viii/Charging valve : Yes

ix/ MS supporting frame work : Yes

viii/Cooling thermostat : Yes

ix/ MS supporting frame work. : Yes

5.0 **CHILLER** (Applicable for chilled water type plant only.)

5.1 Type : Horizontal shell & tube flooded type

5.2 Number required/standby : One no. for each chiller package.

5.3 Design requirements

5.3.1 Fluid to be cooled : Water

5.3.2 Water flow rate (Inside tube) : To suit requirement.

5.3.3 Water inlet temperature : 12 °C approx.

5.3.4 Water outlet temperature : 7 °C approx.

5.3.5 Super heating of refrigerant material : By at least 3 deg. C.

5.3.6 Insulation /thickness/finish : As per the manufacture standard.

5.3.7 Design fouling factor : 0.00010(MKS Unit)



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CENTRAL AIR-CONDITIONING PLANT
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- 5.3.8 Maximum pressure drop. : 0.6 Kg/cm² (g)
- 5.3.9 Tube wall Thickness : Not less than 22 SWG.
- 5.4 Materials of construction
- i/ Shell : M.S. Plate fusion welded.
- ii/ Tube : Integrally Seamless copper (internally Corrugated)
- iii/ Head ends : Cast Iron.
- iv/ Tube sheet material : Steel.
- v/ Baffle plate : Steel.
- 5.5 Accessories required
- i/ Purge & drain : Yes
- ii/ Gate valves at water inlet/outlet. : Yes
- iii/ Flow switch : Yes
- iv/ Pressure/temperature gauges at inlet/outlet : Yes
- v/ Anti-freeze thermostat : Yes
- vi/ Thermostatic expansion valves : Yes
- vii/ Pilot solenoid valve : Yes
- viii/ Cooling thermostat : Yes
- ix/ MS supporting frame work. : Yes

Note :-

The system shall also incorporate:

- 1) Auto operation of chilling plant for operation of the whole AC system.
- 2) A Central Control Panel with fault annunciators with provision for remote extension besides local control kiosks.
- 3) Water Chiller package shall be skid-mounted unit with microprocessor based control panel complete with all accessories and controls are assembled at manufacturing works on single unit.
- 4) Screw chiller shall be suitable for 415V $\pm$ 10 %/50 Hz $\pm$ 3%/3 phase operation with voltage & frequency variation as specified with built in starter etc.
- 5) Only supply feeders shall be provided for chillers.

WVEK KUMAR
 SA Khan Praveen Kishore



TECHNICAL SPECIFICATION

AIR HANDLING UNITS

SPECIFICATION NO.PES-553-02

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SECTION-D

AIR HANDLING UNITS


VIVEK KUMAR SA Khan Praveen Kishore



TECHNICAL SPECIFICATION

AIR HANDLING UNITS

SPECIFICATION NO.PES-553-02

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SHEET 2 OF 5

1. GENERAL

- 1.1 This specification covers the design, manufacture, Construction features, installation, commissioning, inspection and performance testing at site of AHUs.

2. CODES AND STANDARDS

- 2.1 The design manufacture and performance of AHU shall comply with all currently applicable statutes, regulations and safety codes in the locality where the AHU is to be installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this spec. shall be construed to relieve vendor of this responsibility. In particular the equipment shall conform to the latest editions of the following standards:

- 2.1.1 IS-659 : Safety code for air conditioning
- 2.1.2 IS-660 : Safety code for mechanical refrigeration
- 2.1.3 ASHRAE : Method of testing forced circulation air-cooling and air heating coils. standard 33
- 2.1.4 ARI 41 : Standard for forced circulation air cooling and air heating coils.
- 2.1.5 ARI 430/435 : Air-cooling and air heating coils Central Station AHU / Application of Central Station AHU.
- 2.1.6 AMCA : 211 and 311

In case of any conflict in the standards and this specification the decision of PEM,BHEL shall be final and binding.

3. CONSTRUCTION FEATURES

- 3.1 The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m³ density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof.

Necessary arrangement shall be provided on the casing for measuring temperature and pressure in cooling/heating coil. Class of instruments shall be min. 2.

- 3.2 Fan impeller shall be forwardly/backwardly inclined curved blade centrifugal type. Impeller shall be double width double inlet type. Fans shall be preferably low rpm (≤ 1500) to minimize vibration and noise. Noise shall be within 85 dB(A) at 1 metre distance from AHU casing. Max. Vibration level shall be acceptance and norms to be specified. Two to three wheels (impellers) shall be provided for each AHU. Impeller blades shall be fabricated from (min. 1.0 mm) galvanized/ epoxy powder coated sheet steel. Fan shall be of epoxy powder coated / galvanized sheet steel (min. 1.6 mm) scroll with die formed inlets for uniform air flow. Fan shafts shall be solid cold rolled carbon steel (EN8 normalised), ground and polished. Fan shaft bearings shall be of heavy duty type selected for average operating life of 100,00 hours. Bearings shall be self-aligning, permanently lubricated type. Make of Brgs(SKF/FAG/NORMA/TATA) to be specified. Bearing Housing shall be of casting of min. IS Gr. 210, split type and



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- suitably supported. The V-belt drive with belt guard shall be provided. Motors shall have minimum 15% margin over maximum BHP in working range.
- 3.3 DX or chilled water cooling coils and steam/hot water coils shall be internally corrugated copper/ cupronickel tubes (as per manufacturer's standard) with smooth non corrugated external fins of aluminium (thickness 0.14 mm and grade 1100 as per spec) unless specified otherwise in specification. At least 5 fins /per cm. shall be provided. The chilled water/hot water coils shall have suitable (standardize class, size, threading) drain and vent connections.
- 3.4 The filters in the filter section shall be provided as detailed in data sheet A.
- 3.5 Humidifier shall be Pan type/as specified in the specification.
- Pan type Humidifier consisting of SS304/316 tank, heater, geyserstat with piping connection to supply air duct shall be provided unless specified otherwise in data sheet A.
- Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.
- 3.6 Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room. Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized
- 3.7 Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU.
- The AHU shall be provided with 18 G SS drain pan.

WVEK KUMAR
 SA Khan Praveen Kishore



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4. TESTING AND INSPECTION AT MANUFACTURERS WORKS:

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection.

- 4.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.
- 4.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating. For pipes and fittings compliance report shall be furnished by Manufacturer for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.
- 4.3 Shaft: Mechanical and chemical.
- 4.4 Motors (of approved make): Routine TC.
- 4.5 Workmanship and dimensional check as per manufacturing drg. and approved Drgs.
- 4.6 Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked to avoid loosening. Balancing weights and fasteners used shall be galvanized.
- 4.7 Performance test of one Centrifugal fan/per type/per size as per AMCA standard (for indigenous make).
- 4.8 Centrifugal fans for AHUs will be 100% run tested by main contractor of BHEL. One centrifugal fan/per type/per size will be run tested. Vibration shall be within good zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.
- 4.9 Complete assembly of one AHU/per type/ per size (excluding cooling coil and filter) shall be witnessed.
- 4.10 Run test of one complete assembly/per type/per size (excluding cooling coil and filter). Vibration shall be within satisfactory zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

SA Khan, Praveen Kishore
WEEK KUMAR



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5. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

- 5.1 GA drawing of AHU & data- sheet to be submitted along with technical schedules enclosed in Volume III.
- 5.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.
- 5.3 Inspection, operation & Maintenance Manuals.
- 5.4 Equipment description giving complete design calculations, basis of design, selection criteria etc.
- 5.5 Test Certificates.
- 5.6 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.
- 5.7 Performance Test Certificates.


SA Khan Praveen Kishore

VIVEK KUMAR



TITLE

AIR HANDLING UNIT
DATA SHEET - A

SPECIFICATION NO. PE-TS-410-553-A002.

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DESCRIPTION**DATA**

1. Nos. required/working	: Refer to Section-C of Specific technical requirement.
2. Location	: Refer to Section-C of Specific technical requirement.
3. Service/type	: Air Conditioning /Double skin.
4. Fan type	: Centrifugal (forward/backward curve Blade) limit load.
a) Capacity	: To Suit as per calculation.
b) Static pressure	: To suit but not less than 60 mm wc for AHU's Micro-V filters.
c) Discharge direction	: To suit layout.
d) Motor	: By Bidder,
e) Local push button station (Start/Stop)	: By Others
f) Motor location	: Inside AHU Casing.
g) Drive	: Belt, pulley, belt guard.
5. Face and Bypass Damper	: Required (Opposed blade type) DX AHU's having
6. Cooling coil	
a) Duty sensible heat	: To suit as per calculations
b) Duty latent heat	: -do-
c) Type of coil	: Chilled Water/DX/Hot Water.
d) No. of rows	: To suit but not less than four (4)
e) Material of tube /Thickness	: Seamless Copper to ASTM E-75/Equivalent.
f) Material of fins	: Aluminium to SAE-1100-/1145-0
g) Number of fins	: Not greater than 5 per cm (13 per inch).
h) Max. face velocity	: 2.5 m/sec.
i) Air flow quantity	: To suit as per tender drawings/documents.
7. 3 - way motorised mixing valve with thermostat.	: Required with thermostat & actuator for chilled water system for each AHU.

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TITLE

AIR HANDLING UNIT
DATA SHEET - A

SPECIFICATION NO. PE-TS-410-553-A002.

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8.	Damper at discharge	: Manually operated at discharge of each AHU outlet.
	a) Material of construction	: Mild Steel, galvanised.
9.	Filters (Pre-filters)	
	a) Type & thickness	: Dry panel type/ 50 mm
	b) Filter area.	: To suit as per velocity requirements. "V" - Bank.
	c) Filter efficiency	: Average arrestance efficiency of 65-80 %
	d) Press drop (Clean)	: Not to exceed 2.5 mmwc when clean & 6.5 mmwc while dirty.
10.	Humidification section	: As per the System requirement.
	a) Type	: Pan type, unless otherwise specified.
	b) Operation	: Automatic with Humidification.
11.	Fresh air arrangement	: Required.
	a) Fresh air fan	: Tube axial flow fans with motor.
	b) Accessories	: i) Inlet cone with Bird screen. : ii) Dry panel pre-filters, : iii) High efficiency filters for control room areas. : iv) Volume Control Dampers, : v) Supports etc.
12.	Vibration isolator required.	: Yes
13.	Type of vibration isolator.	: Neoprene ribbed Rubber for AHU's.
14.	Any other requirement	: i) In addition to dry panel filters on AHU, High efficiency filters (average arrestance efficiency of 80-90 %) shall be provided in supply air duct side of AHU for all control room and allied areas. : ii) Bidder to also provide suitable electrical strip heaters for winter heating & monsoon reheating with Contactor box etc. Heaters to be interlocked with airstat.
15.	Instrument & controls	: Lot.(including Control box for strip heaters, pan humidifiers etc. in each AHU room.)
16.	Insulation of drain piping	: Lot.

WVEK KUMAR
 SA Khan
 Praveen Kishore



TECHNICAL SPECIFICATION
COOLING TOWER

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SECTION-D
COOLING TOWER

Praveen Kishore
SA Khan Praveen Kishore
Vivek Kumar
VIVEK KUMAR



TECHNICAL SPECIFICATION

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1. GENERAL

- 1.1 this standard specification covers the design, manufacture assembly, inspection & testing at manufacturer's works, suitable painting & packing, delivery, erection & commissioning at site of all materials and equipments for mechanical induced draught cooling tower complete with all accessories as specified hereinafter.

2. CODES & STANDARDS

- 2.1 the design, manufacture, inspection & testing and performance of the cooling tower as specified hereinafter shall comply with the requirements of all applicable latest Indian/British/American standards and codes of practice. the latest editions of the following standards & publications shall be followed in particular:
- 2.1.1 Cooling tower institute USA bulletin ATP-10S: Acceptance test procedure for industrial water-cooling tower.
- 2.1.2 PTC-23 ASME performance test code for Atmospheric water-cooling equipment.
- 2.1.3 In case of any conflict between the above codes & standards and-this specification, the later shall prevail.

3. DESIGN REQUIREMENTS

- 3.1 the cooling tower shall be designed for continuous operation to cool not less than design flow of water from specified inlet temperature to the outlet temperature at a design ambient wet bulb temperature as indicated under data sheet a.
- 3.2 all the components shall be capable of safe, proper and continuous operation at all cooling water flows upto & including those specified under data sheet a & shall be designed with regard to case of maintenance, repair, cleaning & inspection.
- 3.3 the cooling tower shall be of induced draught cross flow or counter flow type and with multiple cells (if specified in data sheet a.) the cooling tower shall be suitable for handling the fluid and also for achieving the specified parameter as per data sheet a. the cooling tower shall be designed such that the drift losses & evaporation losses are minimum.

4. CONSTRUCTIONAL FEATURES

- 4.1 CASING & LOUVERS
- 4.1.1 The cooling tower casing shall be made of FRP/as specified in data sheet A. The louvers shall be made of FRP/as specified. Louvers, if provided, shall be designed for air entry to the tower with low velocity for minimum pressure drop & less chance of recirculation of moist air. To eliminate splash out, louvers shall slope to shed water inwards. Air intake shall be all along the base circumference of the casing & hotdip galvanised expanded metal mesh shall be provided to protect the air intake.
- 4.2 FILL
- 4.2.1 Cooling tower fills shall be made of noncombustible PVC/as specified in data sheet A. The design & arrangement of the fills shall be so as to expose maximum air/water surface with minimum pressure drop.
- 4.3 Drift Eliminators
- 4.3.1 Multi-pass drift eliminators with minimum two pass zig-zag path shall be provided so to minimise the drift losses.

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4.3.2	In case of FRP cooling tower the drift eliminators shall be of multi-blade rotary type.		
4.4	Fans & Accessories		
4.4.1	The fans shall be multiple blade, low speed, high efficiency axial flow type located above the top deck level of the cooling tower. Fan rotating assembly shall be statically & dynamically balanced. The fan blades shall be preferably adjustable in stand still condition for propeller action. The fan shall be either directly mounted on the shaft of a totally enclosed weather proof motor or shall be suitable for V-belt drive.		
4.4.2	The rating of drive motor shall have at least 15% margin over maximum fan power consumption. The design & construction of the drive motor shall be in accordance with enclosed specification for LVAC motors.		
4.5	Water basin		
4.5.1	The material of construction of water basin shall be FRP or RCC as specified in data sheet A. The basin shall be provided as a part of cooling tower in case of FRP construction. The sump shall have sufficient storage capacity for safe operation of AC plant.		
4.6	Hot water distribution system		
4.6.1	Manually operated flow control valves shall be provided in hot water distribution piping such that each cooling tower can be isolated without affecting the operation of other cells.		
4.6.2	The nozzles shall be spaced to give even distribution of water over entire space occupied by top row of fills. The nozzles shall be made of brass /SS 304/316/316L (brass shall be as per manufacturer's standard) unless specified in data sheet A:		
4.6.3	In case of FRP tower water shall be distributed over the fill by means of a multiple area fail safe rotary sprinkler made of PVC pipes fitted on a aluminium alloy (as per manufacturers standard) rotary head and mounted on sealed ball bearings (make) .		
4.7	Access		
4.7.1	A stair case paddle ladder (as per manufacturer's standard) shall be provided external to the cooling tower at one end of each tower along with stairways hand rails etc give safe & convenient access to the top deck from ground level.		
4.8	Painting		
4.8.1	The cooling towers shall be painted with suitable anti-corrosive paint as per approval of purchaser. All galvanized external surfaces shall be painted to match colouring scheme. Before painting galvanized surfaces -etch primer to be applied.		

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5. SHOP INSPECTION & TESTING

- 5.1 Compliance certificates for nozzles (Or rotary sprinkler), piping, fill material, drift eliminator, louvers components etc.
- 5.2 Certificate of conformance for all other material components.
- 5.3 Balancing report for Static & dynamic balancing of fan assembly.

6. TESTS AT SITE

- 6.1 Hydrostatic testing of complete hot water distribution piping at site.

7. PERFORMANCE GUARANTEE

- 7.1 The cooling tower shall be guaranteed to meet the performance requirements as specified & when tested in accordance with ATP-105.
- 7.2 The vendor shall furnish performance curves for the cooling tower showing variations in performance from design duty point with change in approach to wet bulb temperature, cooling range, water loading of cooling tower.


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- 8. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT**
- 8.1 General arrangement drawing of complete cooling tower (showing plan, front elevation and side elevation) incorporating principal dimensions, limits of scope of supply of piping, limits of civil works included showing extent of platforms, walkways, handrails, access doors, staircase etc. and the limits of scope of supply of electrical works.
- 8.2 General arrangement and sectional assembly drawings pertaining to the following components of the cooling tower:
- i) Tower fill with supporting arrangement.
 - ii) Drift eliminator installation and details.
 - iii) Complete hot water distribution system including flow regulating valves, distribution basin/pipes and nozzles etc.
- 8.3 Cooling tower performance curves showing WBT Vs cold-water temperature for design cooling range, 90% cooling range and 110% cooling range at 100%, 90%, and 110% design flow.
- 8.4 Performance curves of cooling tower fans.
- 8.5 Test procedure along with details of tests to be conducted for the offered cooling tower.
- 8.6 Quality Plan along with complete details of the testing and inspection requirements of mechanical and electrical items of the cooling tower in BHEL format.
- 8.7 Operation and maintenance instructions.


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TITLE

COOLING TOWER DATA SHEET - A

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A. GENERAL DATA

- 1) Service : Cooling of condenser water of AC plant.
- 2) Type : Fibreglass reinforced plastic construction induced draught.
- 3) Quantity : Refer to Section-C of Specific Technical Requirements.
- 4) Place of installation : Refer to Section-C of Specific Technical Requirements.

B. DESIGN DATA

- 1) Capacity at specified conditions. : To suit the system requirement.
- 2) Water flow rate : To suit the system requirement.
- 3) Design wet bulb temperature : As per relevant section
- 4) Hot water inlet temperature : To suit requirement.
- 5) Cooled water temperature : To suit requirement.
- 6) Depth of sump Tank : As per manufacturer's standard.

C. MATERIAL

- 1) Sump tank & Casing : FRP
- 2) Louvers : FRP/PVC/Aluminium.
- 3) Type of fill : Non-combustible PVC/Eq.
- 4) Nozzles : Brass with chrome plating/polypropylene.
- 5) Ladder : Hot dip galvanized steel ladder for each tower.
- 6) Bird screen : 25 mm square made of GI/SS wire mesh of 16 gauge.
- 7) Fan impeller : Cast Aluminium Alloy/FRP propeller type and multi-blade aerofoil construction with adjustable pitch..
- 8) Supporting structure : MS with spray galvanization of epoxy painting.
- 9) Strainer : Plant strainer made of GI/SS wire mesh of 16 gauge.

D. ACCESSORIES

- 1) Make up connection : Yes.
- 2) Quick fill connection : Yes.
- 3) Overflow & drain & blow down connection : Yes.
- 4) Access door in louvers/fan deck : Yes (if applicable).

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**COOLING TOWER
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- 5) Supports & supporting structure for mounting : Yes.
- 6) Level switch : Yes.
- 7) Rain protection for motor : Yes (suitable Canopy by Bidder)
- E. ELECTRICAL DATA
- i) Power supply : As per specification attached.
- ii) Motor : As per specification attached.
- F. INSPECTION & TESTING : As per approved quality plan.


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 SA Khan Praveen Kishore



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CENTRIFUGAL PUMPS

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SECTION-D

CENTRIFUGAL PUMPS

Praveen Kishore
SA Khan Praveen Kishore
Vivek Kumar
VIVEK KUMAR



TECHNICAL SPECIFICATION
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1. GENERAL

- 1.1 This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer's or his subcontractor's works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter.

2. CODES AND STANDARDS

- 2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable):
- 2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water.
- 2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump.
- 2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water.
- 2.1.4 BS - 599 : Method of testing Pumps.
- 2.1.5 PTC - '6' : Centrifugal Pumps Power test code
- 2.1.6 API - 610
- 2.1.7 Hydraulic Institute Standards of USA

Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards.

- 2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser's engineering shall be final and binding.

3. DESIGN REQUIREMENTS

- 3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability.
- 3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards..
- 3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.
- 3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A.

4. CONSTRUCTION FEATURES:

4.1 PUMP CASING

- 4.1.1 Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand 1.5 times the maximum pressure developed by the pump at the pumping temperature.



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- 4.1.2 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves or plugged with threaded plugs as required.
- 4.1.3 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.
- 4.1.4 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610
- 4.2 **IMPELLER**
- 4.2.1 Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be checked for eccentricity and statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity. Supplier shall ensure during balancing that wall thickness of impeller vane, shroud etc is maintained above the minimum thickness requirement as per design.
- 4.3 **WEARING RING**
- 4.3.1 Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.
- 4.4 **SHAFT**
- 4.4.1 Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.
- 4.5 **BEARING**
- 4.5.1 Bearings and hydraulic devices, of approved make, (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.
- 4.6 **STUFFING BOX**
- 4.6.1 Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer. Tubings used for connections shall be flexible metallic type preferably SS-304/316. PVC/ rubber tubings are not acceptable.

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4.7 SHAFT COUPLING

4.7.1 The pumps shall be directly coupled to their drives through heavy-duty flexible coupling. Suitable sturdy coupling guards of min. 1.5 mm MS sheet/ Aluminium sheet shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

4.8 BASE PLATE AND SOLE PLATE

4.8.1 Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided. The external corners of the base plate shall be rounded to avoid sharp corners. Drilled holes shall have sufficient space around for proper seating of washer with nut. If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 PRIME MOVER

4.9.1 The drive motor selected shall conform to the requirements of the enclosed motor specifications.

4.10 LIFTING ARRANGEMENT

4.10.1 Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance..


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5. PERFORMANCE REQUIREMENTS

- 5.1 The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.
- 5.2 Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.
- 5.3 Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.
- 5.4 The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.

6. DRIVE RATING

- 6.1 The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.
- 6.2 In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.
- 6.3 The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

7. SCOPE OF INSPECTION AND TESTING

7.1 CASTING

- 7.1.1 The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.
- 7.1.2 Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.
- 7.1.3 Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.
- 7.1.4 Verification of Heat treatment charts (as applicable)
- 7.1.5 Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.
- 7.1.6 Surface finish of Steel castings shall meet MSS SP-55.



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7.2 FORGING

7.2.1 Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.

7.2.2 Verification of heat treatment charts (time temperature) (as applicable).

7.2.3 Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.3 FABRICATED ITEMS

7.3.1 Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.

7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel as per ASME Sec IX.

7.3.3 Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8

7.3.4 Verification of heat treatment charts (time temperature), (as applicable)

7.3.5 **Note:** For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.

7.4 IN PROCESS INSPECTION AND TESTING

7.4.1 Identification Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. Permissible defects and acceptance norms need to be specified. On static parts acceptance norms are as per ASME Sec.III NB 2546.

7.4.2 Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness) as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency.

7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable

- a) Cracks, flakes, seams and laps
- b) Defects giving indications longer than that from a 4mm equivalent flaw.
- c) Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%.
- d) Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.

7.4.4 For static duty components - as per NB 2542.2 of ASME Sec. III

7.4.5 Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage.

Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures

7.4.6 Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.

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7.5 PERFORMANCE TEST

7.5.1 Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked.

- a) Capacity V/s Head
- b) Capacity V/s Power absorbed by pump
- c) Capacity V/s pump efficiency

Note : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity.

7.5.2 NPSH test in case specifically mentioned elsewhere.

7.5.3 Vibration, noise level and temperature rise measurement. Noise level shall be within 85dB(A) at 1 metre distance. Vibration within satisfactory zone of VDI 2056 Group G machines. Temperature shall not exceed ambient + 40 deg. C.

7.5.4 Overall dimensions as per GA drawings. One pump/type/size assembly with job motor shall be mounted on base plate, provided the components are ordered on the same manufacturer.

7.5.5 Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.

7.5.6 Painting and packing as per technical specification.

7.6 TEST AT SITE

7.6.1 The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.

7.7 PERFORMANCE GUARANTEE

7.7.1 The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification. The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head

8. CLEANING, PROTECTION , PAINTING & PACKING

8.1 Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere shall be done to remove all dirt, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere. Flanges, inlet and outlet pipe, etc shall be protected. Packing shall be done as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere.

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 SA KHAN
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9.

DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

9.1

Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include:

a)

Foundation base plate and sole plate details as applicable

b)

Civil foundation and anchor bolts details and loading data

c)

Minimum submergence required for the pump (if applicable)

9.2

Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction and/ make with standard applicable codes.

9.3

Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.

9.4

Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.

9.5

Experience list about the supply and successful operation of similar pumps for similar application.

9.6

A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.

9.7

Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.

9.8

Data sheet-B with all the particulars filled in.

10.

MANUFACTURERS NAME AND TAG. PLATES

10.1

Each pump shall have a permanently attached brass/ Stainless steel tag on the body indicating the following information both in Hindi and English:

a)

Manufacturer's name and trade mark.

b)

Design Capacity and Head.

c)

Design.

d)

Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

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11. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

- 11.1 Certified GA drawings of pump motor assembly weights, crane.
- 11.2 Detailed cross sectional drawings of the pump and motor assembly and all equipment & accessories supplied under the this specification along with details of material of construction with applicable standard codes.
- 11.3 Foundation drawings with details of foundation pocket indicating static as well as dynamic load and other data with dimensions.
- 11.4 Certified characteristics curves (discharge capacity vs. head, BHP and efficiency) of each type of pump and motor.
- 11.5 Material and other test certificates as required by the application clauses of this specification.
- 11.6 Motor speed torque curves super imposed on pump speed torque curves.
- 11.7 Quality plan along with complete details of testing and inspection requirements of centrifugal pumps in BHEL format. Vendor shall also furnish Field Quality Plan.
- 11.8 Installation , operation and maintenance manual.
- 11.9 Other drawings and data, if necessary.


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TITLE

CENTRIFUGAL PUMPS**DATA SHEET - A**

SPECIFICATION NO. PE-TS-410-553-A004.

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DESCRIPTION**DATA**

1. Designation	: Condenser water and Chilled Water pumps for AC plant.
2. Type	: Horizontal, Centrifugal pump or vertical split type casing pump .
3. Quantity	: Refer to section-C of Specific Technical Requirements
4. Installation	: On floating type foundation.
5. Fluid to be handled	: Water
6. Temperature of fluid	: To suit.
7. Capacity M3/hr and TDH at rated	: To suit system requirements but head shall not be less than 25 MWC.
8. Duty	: Continuous (24 hours / day)
9. Suction condition	: Flooded
10. Type of drive	: Direct
11. Prime Mover	: LV AC motor
12. Maximum speed	: 1500 RPM
13. Type of lubrication	: Grease Lubrication
14. Material	
a) Impeller	: Bronze to Grade IS: 318 Grade 2
b) Pump shaft	: EN - 8 / Equivalent (Approved).
c) Casing	: CAST IRON TO IS: 210 Grade - 260.
d) Wearing ring	: Bronze to Grade IS:318 GR-2, Renewable type.
e) Shaft Sleeve	: -do-
f) Base plate	: Cast Iron to Grade FG-200 IS-210/M.S. fabricated.
g) Bolt and nuts.	: MS
h) Stuffing Box gland/bush	: Deep Bronze packing to be renewable with case.
i) Stuffing box Packing.	: Flexible Graphite or PTFE (Asbestos shall not be used)
j) Pump motor coupling.	: Flexible.

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TITLE

CENTRIFUGAL PUMPS
DATA SHEET - A

SPECIFICATION NO. PE-TS-410-553-A004.

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15. **ACCESSORIES REQUIRED:-**

The following accessories shall be provided by the bidder for each pump:

a) Suction & Discharge pressure gauges.	: Yes.
b) Vent connection	: Yes.
c) Drain piping up to common drain point in plant room.	: Yes
d) Companion flanges.	: Yes
e) Common base plate.	: Yes.
f) Suction strainer.	: Yes
g) Isolating valve	: Yes
h) NRV at pump outlet at inlet/outlet	: Yes
i) Any special requirements	: The Chilled Water pumps shall be suitably insulated as per spec.
j) Inspection & Testing	: As per specification enclosed elsewhere.


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**TECHNICAL SPECIFICATION
PACKAGE CONDITIONING UNIT**

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**SECTION-D
PACKAGE CONDITIONING UNIT**


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TECHNICAL SPECIFICATION
PACKAGE CONDITIONING UNIT

SPECIFICATION NO.PES-553-05

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1 **GENERAL**

1.1 This specification covers the design, manufacture, inspection and testing at the manufacturer's works and suitable packing delivery and testing of the packaged air conditioning unit.

2 **CODES AND STANDARDS**

2.1 The design, manufacture, inspection, testing and performance of the packaged type air conditioning unit shall comply with all statutes, regulations and safety codes currently applicable in the locality where the equipment will be installed. The equipment shall also conform to the latest editions of the codes and standards specified herein under. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

In particular, the packaged air conditioning Unit (max 7.5 TR capacity, ductable or non ductable type) or cassette type (up to 5 TR) shall conform to the latest editions of the following standards:

2.1.1	I.S.660	: Safety code for Mechanical Refrigeration.
2.1.2	I.S.5111	: Code of practice for measurement, and testing of refrigerant compressor.
2.1.3	I.S.659	: Safety code for air conditioning.
2.1.4	I.S.2494	: V Belt for industrial purpose.
2.1.5	I.S.3142	: V grooved pulleys for V Belts.
2.1.6	I.S.4503	: Shell and tube type heat exchanger.
2.1.7	ARI 210	: Standard for/unitary air conditioning equipment
2.1.8	ARI 270	: Standard for application installation and servicing of unitary equipment.
2.1.9	ASHRAE-37	: Standard methods of testing for rating unitary air conditioning and heat pump / equipment.
2.1.10	ANSI-B9-1	: Safety code for mechanical refrigeration.

3 **DESIGN AND CONSTRUCTIONAL REQUIREMENTS**

3.1 **Compressor**

The compressor shall be hermetic or semi-hermetic or screw rotary type or scroll type. The same shall be suitable for R410A/R407C/R134A refrigerant. The compressor shall be mounted on anti-vibration spring/rubber pads and shall be positioned in such a way that it is freely accessible with sufficient space all around for easy maintenance. Safety controls like High and Low pressure cut-out overload and single phasing protection for the motors shall be provided. A crankcase heater shall also be provided, if considered necessary by the vendor.

3.2 **CONDENSING UNIT**

Shell and tube type water cooled condenser or air cooled condenser with adequate area shall be provided as specified in Data Sheet-A. The condensing unit shall be complete with multipass heads and shall be fitted with the following:



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- 3.2.1 Hot gas inlet and liquid outlet connection with shut off valve for liquid.
- 3.2.2 Drain plug, air vent and test valve.
- 3.2.3 Water inlet and outlet connection with thermowell and suitable cocks respectively.
- 3.2.4 Relief valve and air purge valve (Fusible plug in place of relief valve not acceptable)
- 3.2.5 Any other accessory as recommended by the manufacturer for proper functioning of the equipment.
- 3.3 AIR HANDLING FAN**
- The air handling fan shall be of the centrifugal type and with forward curved blades. This shall be driven by means of a three phase induction motor through V belt drive. The fan static pressure shall be selected for passing air through high efficiency absolute filters, if specified in Data Sheet-A.
- 3.4 FILTERS**
- Filters shall be of dry panel type and shall be cleanable. The velocity of air across the filters shall not exceed 1.75m/sec (350FPM).
- 3.5 COOLING COIL**
- The cooling coil shall be of direct expansion type and shall be made of heavy gauge copper with aluminium fins. The fins shall be bonded to the copper tubes under hydraulic pressure. A distributor shall be provided for feeding the refrigerant to different sections of the coil. Rows shall be staggered in the directions of airflow. The velocity of air across coil shall not exceed 2.5M/Sec. (500 FPM).
- 3.6 CONTROLS**
- All necessary controls and accessories like thermostatic expansion valve, refrigerant solenoid valve, distributor, filter drier in the liquid lines, shut off valves, HP/LP cut out for compressor, thermostat with adjustable settings, overload and single phasing preventer for motor etc. are to be provided. The microprocessor based control panel shall be provided outside the packaged unit on one side. The control panel shall generally be in line with the specification for control panels given elsewhere.
- The control shall be so interlocked that the fan shall be started independently first, and then only the compressor. Tripping of the compressor by the thermostat or compressor cut outs shall not trip the fan. The thermostat setting shall be adjustable
- 3.7 REFRIGERANT PIPING**
- The refrigerant piping shall be either heavy gauge copper as furnished in Data Sheet-A. The piping shall be completely factory assembled, pressure tested, dehydrated and initially charged with FREON gas and compressor oil. The line accessories shall include liquid line shutoff valve dehydrator, strainer, flow indicator and distributor etc.
- 3.8 CABINET**
- All the equipments, except control panel, mentioned above shall be provided within a heavy gauge sheet metal cabinet, of floor/ wall mounted type. This shall be given two coats of anti-corrosive and rust proof paint, finished with two coats of final paint . Painting shall be as per manufacturers std unless specified otherwise in data sheet 'A'. The interior of the cabinet shall be provided with thermal and acoustic insulation of minimum 25mm thick. The insulating material shall be fire proof.
- The front and back side of the cabinets shall be easily removable providing maintenance to all the interior parts.
- All the electric wires within the cabinet shall run in flexible conduits and carry

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 VIREK KUMAR
 SA Khan, Praveen Kishore



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identification tags. The bottom side of the panel shall be specially ribbed to take care of the transportation.

3.9 OTHER ACCESSORIES

Each packaged air conditioner shall be provided with required number of neoprene rubber isolating pads.

4 CONTROL AND INTERLOCK REQUIREMENTS

The compressor shall have all protective devices like HP/LP cutouts, overload protection for the motor, single phasing preventor for motor etc.

The interlocking requirement shall be as indicated below:

4.1 The compressor shall not start, unless condenser water flow is achieved for water cooled condenser. The condenser flow shall be sensed by means of a flow switch.

4.2 The compressor shall not start unless the evaporator fan is started.

4.3 The tripping of compressor on HP/LP, overload or on thermostat shall not trip the fan.

4.4 Strip heater (if provided in the ducting system) shall not be switched on, unless the evaporator fan is started and airflow is established. For this purpose, an air stat on flow switch shall be used. The heater shall be separately controlled by humidistat/thermostat

4.5 A humidifying package, if specified in data sheet A, shall be controlled by humidistat.

5 TEST AND INSPECTION

5.1 Inspection and Testing at Manufacturer's Works

5.1.1 static and dynamic test for fans

5.1.2 Hydrostatic static test on condenser and cooling coil.

5.1.3 vacuum/pressure test for the complete refrigeration circuit.

5.1.4 Visual and Free running test of the packaged unit on test bed.

5.1.5 Free running test on compressor.

5.1.6 AIR CAPACITY WITH ANEMOMETER.

5.1.7 NOISE LEVEL- ≤ 85 dB(A).

5.1.8 Other tests as per approved qualities plan/scope of inspection.

5.2 Inspection and Testing at Site

5.2.1 Performance testing of the packaged unit for 72 hours in summer / monsoon & 24 hours in winter. Up-to 3 TR (individual M/c capacity) inside room temperature (Dry & wet bulb) will be checked with all machines in the room operating.

The actual days of testing shall be mutually agreed. During the above testing, the following readings shall be taken to compare the same with guaranteed performance data.

5.2.1.1 Condenser inlet and outlet pressure and temperature

5.2.1.2 Entering and leaving air temperature of the cooling coil air filters.

5.2.1.3 Motor current for the compressor and blower.

5.2.1.4 Air quantity delivered by the fan. This shall be computed by adding air quantity leaving all the grilles entering the air filters.



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- 5.2.1.5 Room temperature (Dry & wet bulb)
- Test to ensure all controls and safety instruments are working properly.
- During the above testing, noise level also will be checked to ensure that the same are within acceptable limits. Any undue vibration detected physically will be corrected.
- All tools and instruments required for the above testing will be provided by the vendor.
- 6 PAINTING:**
- The packaged unit shall be given two coats of primer paint finished with two coats of finish paint as per Manufacturers std. unless specified otherwise elsewhere/ Data sheet 'A'. The colour of finish paint will be as specified in Data Sheet-A.
- 7 GUARANTEES**
- The package unit shall be guaranteed for performance measured in terms of the inside temperature maintained.
- The packaged unit shall also be free from any manufacturing defects and shall be guaranteed as per contract after the first test as per 5.0 is successfully carried out, and the plant taken over by the purchaser.
- 8 NAME PLATES**
- Suitable Name plate as per Data Sheet 'A', depicting the equipment number as designated in Data Sheet A shall be provided for each packaged unit and screwed to a prominent position on the packaged unit.

Praveen Kishore
SA Khan
VIVEK KUMAR



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9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

- 9.1 Final technical data as per Data Sheet-B
- 9.2 G.A. and interior view of packaged unit
- 9.3 Electrical wiring diagram
- 9.4 Catalogues for all controls
- 9.5 O & M Manual
- 9.6 Erection Manual


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SA Khan Praveen Kishore



TITLE

PACKAGE-CONDITIONING UNIT**DATA SHEET - A**

SPECIFICATION NO. PE-TS-410-553-A00.

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SECTION D

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DATE APRIL 2015

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DESCRIPTION**DATA**

1) Capacity of the unit at operating conditions.	: As specified
2) Numbers required	: Refer to Section-C of Specific Technical Requirements
3) Designation of the unit	: Package AC Unit
4) Whether air cooled/water cooled	: Refer to Section-C of Specific Technical Requirements
5) The plant shall be suitable for maximum-ambient temp.	: Refer outdoor design condition as specified.
6) Whether a plenum Chamber required	: Units shall be connected to fresh air ducts.
OR	
Whether to be connected duct system.	: Yes.
7) Whether Humidifier required for humidity-control.	: Refer to Section-C of Specific Technical Requirements
8) Whether strip heaters required for winter heating.	: Refer to Section-C of Specific Technical Requirements
9) Whether strip heater required for Humidity control.	: Refer to Section-C of Specific Technical Requirements
10) Final painting colour shade stage.	: Subject to approval / during detail engineering
11) Whether fan static pressure is to be designed for filters arrangement shown.	: Yes.
12) Installation supporting structure/drain piping, insulation.	: Required. Drain piping with insulation up to the nearest drain point.
13) Controls & Instruments	: Yes (Lot)
14) Isolation Switch	: Yes

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TECHNICAL SPECIFICATION

AIR FILTER

SPECIFICATION NO.PES-553-06

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DATE: 17.09.2012

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SECTION-D

AIR FILTER


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TECHNICAL SPECIFICATION

AIR FILTER

SPECIFICATION NO. PES-553-06

VOLUME II B

SECTION D

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DATE: 17.09.2012

SHEET 2 OF 4

1. GENERAL

This specification covers the design, manufacture, inspection and testing at manufacturer's work or his sub-contractor's works of Air filters to be used for air-conditioning and ventilation system.

2. CODES AND STANDARDS

This design, manufacture and performance of AIR FILTERS shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to latest applicable Indian/British/USA standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. The following standards, in particular, shall be applicable for certified ratings of filters and for conducting performance test, if required.

a) BS EN - 779 -Methods of test for air filters used in air conditioning and general ventilation.

3. GENERAL

The enclosed Data sheet A gives the type and other particulars of filters required.

3.1 POLY FIBRE AIR FILTERS

Filtering media shall consist of a suitable fibrous material (e.g. polyethylene extruded sections coir etc.) packed into a 20 gauges GSS framework, complete with handles etc. The filter element shall be supported by galvanised steel wire mesh of 10mm. sq. on either side, Velocity across the filters shall not exceed 2.5 M/sec. Average efficiency Em (%) shall be ≥ 80 as per BS EN - 779.

3.2 DRY FABRIC AIR FILTERS

Filter element shall be pressed felt filter fabric or suitable material recommended by the manufacturer, stitched on to galvanised wire gauge support and crimped to form deep folds. Suitable aluminium spacers shall be provided to ensure uniform distribution of air flow through filters. Filter casing shall be provided with neoprene sponge rubber sealing, The filter shall have Average efficiency Em (%) of ≥ 95 as per BS EN - 779.

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

Filter shall consist of V-fold galvanised wire mesh interspaced with flat layers of galvanised wire mesh. The density of media shall increase in the direction of air flow. Edges of wire mesh shall be suitably hemmed to prevent abrasion during handling. The media shall be supported on either side by galvanised expanded metal casing. The framework shall be at least 18 gauge GSS. Filter shall be either dry or wetted type as per data sheet=A. The oil shall be mineral oil of approved quality and make. As a the filter frame made of Aluminium alloy conforming to IS:737 can be considered unless use of aluminium is prohibited otherwise due to site conditions being saline/corrosive.

All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance Am (%) shall be ≥ 90 . However oil wetted air filters shall have Average Efficiency Em (%) ≥ 90 as per BS EN - 779.

3.4 AUTOMATIC CLEANING FILTERS

This shall consist of a filter mat and drop eliminator, driven by a suitably rated gear

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Praveen Kishore



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AIR FILTER

SPECIFICATION NO.PES-553-06

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motor unit being supported on a steel framework. The filter mat shall consist of an endless steel wire mat insets of steel mesh held between an upper & a lower shall drop eliminator shall consist of an endless steel wire without insets of steel mesh. The unit shall include a suitable oil pump, gladge raking mechanism and sludge container and tensioning device. Pressure drop shall be limited to 0.5 / mm WG when clean & 10 mm when dirty. Air velocity across filter shall not exceed 3 M/sec.

3.5 ABSOLUTE FILTERS

Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctyphalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame.

3.6 WATER REPELLANT NYLON FILTERS

This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only.

4. INSPECTION & TESTING

The scope of inspection for air filters shall be as below:

4.1 Dimensional inspection of frame & filter media.

4.2 Witnessing of type tests on one per type per size air filters for the following properties.

- a) Gravimetric efficiency.
- b) Pressure drop in clean & dirty (choked - %age to be specified) condition.
- c) Efficiency as per BS EN - 779.

4.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet).

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WWEK KUMAR



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5. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

- 5.1 GA Drawing.
- 5.2 Drawing showing material/construction detail
- 5.3 Installation and\service manual
- 5.4 Rating curves/charts
- 5.5 Test certificates
- 5.6 Elect. diagrams (when automatic cleaning type)


VIVEK KUMAR
SA Khan Praveen Kishore



TITLE

**AIR FILTER
DATA SHEET - A**

SPECIFICATION NO. PE-TS-410-553-A006

VOLUME II-B

SECTION D

REV 00

DATE APRIL 2015

SHEET 1 OF 1

DESCRIPTION**DATA****1) General**

1.1 Service	: Air Conditioning.
1.2 Location	: Central Air conditioning plant, & package AC plant, fresh air fan system. Also for split AC.
1.3 Nos.	: Refer Section 'C' of Specification.
1.4 Total air flow/type	: Refer Section 'C' of Specification.
1.5 Temperature	: As per project information.
1.6 Relative Humidity	: 100%
1.7 Gas Composition	: Atmospheric Air (Dusty) as prevalent in power Station.
1.8 Filter Media	: Synthetic non-woven
1.9 Efficiency	: Average arrestance efficiency of 65-80 % for Dry Panel filter (pre-filters) and average arrestance Efficiency of 80-90 % for fine filters.
1.10 Allowable pressure drop	: 2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters(prefilters). 12 mm in clean condition for fine filters.
1.11 Frame Work	: 18 G, GSS.
1.12 Mounting	: Ladder Type M.S Angles (galvanised)
1.13 Size	: 600 x 600 mm

Note:-

- 1) Face velocity of air across the filters shall not exceed 2.5 m/sec.

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 Praveen Kishore



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

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SECTION-D
LOW PRESSURE AIR DISTRIBUTION SYSTEM

Praveen Kishore
SA Khan Praveen Kishore
Vivek Kumar
VIVEK KUMAR



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
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1. GENERAL

- 1.1 This specification covers the design, manufacture, construction features, installation, inspection testing and air balancing of air distribution system upto a total pressure of 95mm w.g. The specification is intended to cover the air distribution for air conditioning system and ventilation system not involving localised exhaust.

2. CODES AND STANDARDS

- 2.1 The design, construction and performance of complete system shall conform to all currently applicable statutes, regulations, safety codes in the locality where the equipment are to installed
- 2.2 Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the following standards:-
- a) IS: 655 - Specifications for metal air ducts.
 - b) IS: 277 - Specifications for galvanised steel sheets.
 - c) IS: 737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

3. MATERIAL

- 3.1 Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.
- 3.2 The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per technical requirement refer to Section-C of Specific Technical Requirements.
- 3.3 The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest

4. CONSTRUCTION/FABRICATION

- 4.1 The thickness of sheets, the type of bracing and other fabrication details shall generally conform to requirements given hereunder unless specified otherwise in data sheet A and/or indicated on drawings.

4.2 RECTANGULAR DUCTS

4.2.1

S.No.	Max Side	Sheet Thickness		Type of transverse Joint connections	Bracings
		(mm) GI	(mm) Al		
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None



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b)	601 to 750	0.63 (24G)	0.80	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles,connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

- 4.2.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.
- 4.2.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.
- 4.2.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:
- Upto 1000mm - 6 mm dia GI bolts
 - 1001 to 1500 - 8 mm dia GI bolts
 - 1501 and above - 10mm dia GI bolts
- 4.2.5 The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.
- 4.2.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.



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4.3 ROUND DUCTS

4.3.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) AI	
a)	Up to 150	0.63 (24G)	0.80	None
b)	151 to 600	0.80 (22G)	1.00	None
c)	601 to 1000	1.00 (20G)	1.50	40x40x3mm girth MS
d)	1001 to 1250	1.00 (20G)	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

4.3.2 The seams on round ducts may be continuously welded or grooved longitudinal seam. In case of welding of GI sheet, zinc rich paint shall be applied on the welded zone.

4.3.3 Round ducts shall either be joined by welding or the ducts shall be swedged 40mm from the ends such that larger end will butt against the swedge and is held in place with sheet metal screws.

4.4 DUCT SUPPORTS

Unless specified otherwise on drawings, rectangular ducts with larger side of 2250mm or above shall be supported by 15mm MS rods and 50x50x3mm and MS angles while those below 2250 mm shall be supported by 10mm MS rods and all angles shall be given a coat of primer paint. The duct supports shall be at a distance not exceeding 1800mm. The MS rods shall be fixed to MS angle cleats, which in turn are fixed to ceiling slab by suitable anchor fasteners. All anchor fasteners, MS angle cleats, coach screws, hooks and other supporting material required shall be provided by vendor.

However, If ducts are thermally insulated, the MS angles and supports shall not be in direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.

4.5 FLEXIBLE CONNECTIONS

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band 9r (or) collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

4.6 TRANSFORMATIONS AND BREACHES

All curves, bends, offsets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.



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4.7

CAULKING

Wherever duct passes through wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.

4.8

EASEMENT

Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.

4.9

ACCESS DOORS

Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc.

All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.

4.10

DAMPERS AND SPLITTERS

4.10.1

Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.

4.10.2

FIRE DAMPERS

Fire dampers shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal sensor or fusible link type.

4.10.3

VANES

Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.

4.10.4

FLASHING

For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.

4.11

DIFFUSERS AND GRILLS

The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser.

Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be



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single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.

4.12

PLENUMS AND RA BOXING

All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at approx. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonry construction to which angles are fastened.

Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box ~~shall be~~ fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.

4.13

ACCOUSTIC LINING

The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.

4.14

PAINTING

Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.

4.15

THERMAL INSULATION

Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.

5.

INSPECTION AND TESTING

5.1

INSPECTION & TESTING DURING FABRICATION

5.1.1

Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.

5.1.2

Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

5.1.3

Check for dimensions & mass as per latest IS-277.

5.1.4

Check for defect, twists, ungalvanised spots as per IS-2629.

5.1.5

Bend test & wrapping test as per IS-277.

5.1.6

Zinc coating test on samples as per IS-6745.

5.2

INSPECTION & TESTING AT SITE.

5.2.1

The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.

5.2.2

After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.



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6. BALANCING

6.1.1 The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit

6.1.2 All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.


VIVEK KUMAR
SA Khan, Praveen Kishore



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
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7. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT

- 7.1 Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.
- 7.2 Test certificates in line with scope of inspection.
- 7.3 Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual.

Praveen Kishore
SA Khan Praveen Kishore
Vivek Kumar
VIVEK KUMAR



TITLE

LOW PRESSURE AIR DISTRIBUTION SYSTEM**DATA SHEET - A**

SPECIFICATION NO. PE-TS-410-553-A007

VOLUME II-B

SECTION D

REV 00

DATE APRIL 2015

SHEET 1 OF 1

Description**Data**

1. General (List of areas)	: As per Specification/Tender drawing.
2. GSS Duct Work	
a) Type	: GSS as per IS: 277 (Zinc coating as per Section-C of Specific Technical Requirements.)
b) Size	: As per Section-C of Specific Technical Requirements and bill of quantity.
3. Acoustic lining	: Up to 5m length from AHU Outlet.
4. Special painting	: Galvanised.
5. Thermal Insulation	: Required in supply air duct in AC entire length.
6. Diffusers (Circular/Square)	
300 mm size	
350 mm size	
450 mm size	
550 mm size	
600 mm size	
Any other size	
7. SA grilles (for each size)	: Bidder to estimate as per drawings./specification. All grille frame and louvers shall be manufactured of at least 16 SWG Aluminium
8. RA grilles (for each size)	: To suit air flow as per System requirements / Tender Drawings.
	: -do-

NOTE:

- Duct sheet thickness shall be as per IS-655
- Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
- Bidder to provide suitable gasketing at each duct flange.
- Fire damper shall be motor operated type, when otherwise specified under Section-C.
- Access door in ducting system shall be provided as required.
- MS Angle (painted) shall be used for duct supports etc.
- Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.
- All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.

WWEK KUMAR
SA Khan
Praveen Kishore



TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-410-553-A001

VOLUME III

REV. 00

DATE: MARCH 2015

VOLUMN-III


VIVEK KUMAR
SA Khan Praveen Kishore

SECTION-1

LIST OF DOCUMENTS TO BE SUBMITTED WITH BID

1. Signed and Stamped copy of Complete Technical Specification (4 Sets)
2. Signed and Stamped copy of No Deviation certificate (4 Sets)
3. Signed and Stamped copy of Un-Priced Schedule (4 Sets)
4. Signed and Stamped copy of Guarantee Power consumption (4 Sets)
5. Signed and Stamped copy of Compliance cum Confirmation Certificate (4 Sets)


VIVEK KUMAR SA Khan Praveen Kishore



TITLE:

1X800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION
COMPLIANCE CUM CONFIRMATION
CERTIFICATE

SPEC. NO.: PE-TS-410-553-A001

VOLUME: III

SECTION:

REV. NO. 00

SHEET 1 OF 2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

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

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

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account



TITLE:

1X800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION
COMPLIANCE CUM CONFIRMATION
CERTIFICATE

SPEC. NO.: PE-TS-410-553-A001

VOLUME: III

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REV. NO. 00

SHEET 2 OF 2

- 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 to the vendor in writing and require written approval. Unless any change in specific 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.

Praveen Kishore
SA Khan
VIVEK KUMAR



TITLE SECTION-2
1x800 MW KOTHAGUDEM TPP
AIR CONDITIONING SYSTEM
PRE-BID CLARIFICATION SCHEDULE

SPECIFICATION NO. PE-TS-410-553-A001
VOLUME: III
REV 00
March 2015
Page 1 of 1

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


VIVEK KUMAR
SA Khan Praveen Kishore

BHEL

NAME OF VENDOR:-

TECHNICAL DEVIATIONS

WVEX KUMAR SA KHAN Praveen Kishore

NAME	DESIGNATIONS	SIGN & DATE	COMPANY SEAL

1. Cost 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 Deviations in detail in the above format on cost basis (if any).
3. Any deviation not mentioned above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.

4. Bidder shall indicate "quoted" in cost of deviation column of the schedule above along with their Technical offer.
5. Bidder shall furnish priced schedule of technical deviation along with price bid in sealed envelop.
6. The final decision of acceptance/ rejection of the deviations quoted by the bidder along with its cost shall be at discretion of the Purchaser.
7. Bidders to note that any deviation not listed above and asked after Part I Bid opening shall not be considered.
8. Bidders to note that no Price Impact will be acceptable after Part I Bid opening subject to if there is any change in Technical Specification/NIT terms from BHEL side.
9. Deviation listed above without any cost of deviation, if found acceptable to BHEL, will be considered without any price implication.


 Anil Kumar
 Vice Chairman
 BHEL

SECTION-4

FORMAT FOR NO DEVIATION CERTIFICATE **(To be submitted in the bidder's letter head)**

BHARAT HEAVY ELECTRICALS LIMITED,
Power Sector – Project Engineering Management,
PPEI Building, Plot No. 25, sector-16A
Noida -201301(U.P)

Sub	No Deviation Certificate	
	Design, engineering, manufacturing, supply, erection, commissioning etc of AC System for Kothagudem 1 x 800 MW TPS	
Ref	01	Tendor No.
	02	BHEL 's NIT, vide reference no.
	03	BHEL's clarification / confirmation vide reference email dated
	04	Other reference (if any)/

Dear Sirs,

With reference to above, this is to confirm that as per tender conditions, we have visited site before submission of our offer and noted the job content & site conditions etc. We also confirm that we have not changed / modified the tender documents as appeared in the web site / issued by you and in case of such observance at any stage, it shall be treated as null and void.

We hereby confirm that we have not taken any deviation from tender clauses together with offer references as enumerated in the above referred NIT (besides the confirmations given at Sl. No. 03 under Ref.). We hereby confirm our unqualified acceptance to all terms & conditions, unqualified compliance to technical specification and acceptance to reverse auctioning process.

In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted offer in accordance with tender instructions and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized
representative of the bidder)


VIVEK KUMAR
SA Khan Praveen Kishore

SUGGESTIVE PRICE FORMAT														
B-SCH NO	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY	UNIT	SUPPLY						ERECTION & COMMISSIONING				
				Unit Price (Rs)	Total ex-works price (Rs)	ED including CESS (Rs)	CST / VAT (Rs)	FREIGHT including Service Tax, If applicable (Rs)	TOTAL F.O.R. Site Price Supply (Rs)	Unit Price (Rs)	Total Price (Rs)	Service Tax (Rs)	Total Price (Erection & Commissioning) including Service Tax	Total Price Supply FOR Site and E & C including service tax (Rs)
1.0	LUMPSUM PRICES													
1.1	Total lumpsum firm prices for equipment & Services as specified, Comprising design, manufacture, supply, inspection & Testing at manufacturers works, Painting at manufacturers works, duty packed for transportation, delivery to site, unloading storage & handling at site, erection & commissioning, carrying out acceptance tests at site & final painting of complete Air Conditioning on turnkey basis as per specification PE-TS-410-553-A001 including special tool & tacksels for maintenance, commissioning spares, all taxes, duties etc.													
2.0	Break up prices for items covered in clause 1.0 above. In case, price indicated above does not match with item wise break-up given at 2.0, the highest price so calculated shall be considered for evaluation in case of order.													
2.1	AC PLANT -1 (Main control room areas in power house building & Service Building)													
2.1.1	SCREW CHILLERS package, each of minimum 350 TR capacity consisting of Screw refrigerant compressor complete with motors, control panel, multi drive set, controls and interlocks other accessories as specified, water cooled condenser of matching capacity, shell & tube type water chiller & other accessories, as specified.	2	NO											
2.1.2	Sheet metal cabinet type double skin AIR HANDLING UNITS consisting of chilled water cooling coil, centrifugal blower, TEFC sq cage induction motor, drive set, filters (pre filter), 3 way motorised mixing valve with thermostatic controls and other accessories to meet the AC load of control room areas at +17.00 M of power house building.	2	NO											
2.1.3	FINE FILTERS in Common discharge plenum for AHUs at 24.0 M level, complete with fixing frame, nuts, bolts, washers and other items required for complete installation of fine filters	1	LOT											
2.1.4	Sheet metal cabinet type double skin AIR HANDLING UNITS consisting of chilled water cooling coil, centrifugal blower, TEFC sq cage induction motor, drive set, filters (pre filter), 3 way motorised mixing valve with thermostatic controls and other accessories to meet the AC load of control room areas at +8.5.00 M of power house building.	2	NO											
2.1.5	FINE FILTERS in Common discharge plenum for AHUs at 8.5 M level, complete with fixing frame, nuts, bolts, washers and other items required for complete installation of fine filters	1	LOT											
2.1.6	Sheet metal cabinet type double skin AIR HANDLING UNITS consisting of chilled water cooling coil, centrifugal blower, TEFC sq cage induction motor, drive set, filters (pre filter), 3 way motorised mixing valve with thermostatic controls and other accessories to meet the AC load requirement of Service Building .	10	NO											
2.1.7	FINE FILTERS in Common discharge plenum for AHUs of service building, complete with fixing frame, nuts, bolts, washers and other items required for complete installation of fine filters	1	LOT											
2.1.8	Fibreglass reinforced plastic (FRP) construction COOLING TOWER complete with fan, motor, FRP basin, nozzles, make up, quick fill, equalising and drain water connection, level switch, ladder & all accessories as specified.	2	NO											
2.1.9	CENTRIFUGAL PUMPS sets for condenser water recirculation complete with TEFC motor & all accessories as specified.	2	NO											
2.1.10	CENTRIFUGAL PUMPS for chilled water recirculation complete with TEFC motor & all accessories as specified..	2	NO											
2.1.11*	FAN COIL UNIT consisting of chilled water cooling coil, blower, motor, drive set, filters (pre filter), 3 way motorised mixing valve with thermostatic controls and other accessories													
2.1.11.1*	3.0TR	2	NO*											
2.1.11.2*	2.0TR	2	NO*											
2.1.11.3*	1.5TR	2	NO*											
2.1.12	WATER STORAGE TANK of capacity 8 Cubm. Tanks shall be in MS/ FRP construction. Make up water line with float valve & backup, quick fill line with ball valve, drain line with ball valve, overflow & vent line, level gauge shall be provided.	2	NO											
2.1.13	CHILLED WATER EXPANSION TANK of capacity 1 Cubm. Tanks shall be MS/FRP & insulated as per specification. Make up water line with float valve & backup, quick fill line with ball valve, drain line with ball valve, overflow & vent line, level gauge shall be provided.	1	NO											
2.1.14	Non Chemical Treatment Equipment	1	LOT											
2.1.15	CONDENSER WATER PIPING with necessary fittings like tees, reducers, expanders, elbows, flanges, all types of valves with flanges, strainers with flanges, air vents etc as per specifications. This item shall cover the entire condenser water piping (pipe, valves, strainers and all supporting accessories).	1	LOT											

B-SCH NO	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY	UNIT	SUPPLY						ERECTION & COMMISSIONING				
				Unit Price (Rs)	Total ex-works price (Rs)	ED including CESS (Rs)	CST / VAT (Rs)	FREIGHT including Service Tax, if applicable (Rs)	TOTAL F.O.R. Site Price Supply (Rs)	Unit Price (Rs)	Total Price (Rs)	Service Tax (Rs)	Total Price (Erection & Commissioning) including Service Tax)	Total Price Supply FOR Site and E & C including service tax (Rs)
2.1.16	INSULATED CHILLED WATER PIPING with necessary fittings like tees, reducers, expanders, elbows, flanges, all types of valves with flanges, strainers with flanges, air vents etc as per specifications. This item shall cover the entire chilled water piping for AC plant room, all the AHU rooms and FCUs and the interconnecting pipes between AC plant and AHUs, FCUs of all the buildings (pipe, valves, strainers, insulation material with all ancillaries for insulation finishing as per specifications.).	1	LOT											
2.1.17	MS medium class DRAIN WATER PIPING from various equipment like cooling tower (including equalising line), condenser water pumps etc upto nearest available drain point with necessary fittings like tees, reducers, expanders, elbows, flanges, valves with flanges, P trap etc as per specifications.	1	LOT											
2.1.18	MS medium class INSULATED DRAIN WATER PIPING from various equipment like AHUs (including equalising line), FCUs, chilled water pumps etc upto nearest available drain point with necessary fittings like tees, reducers, expanders, elbows, flanges, valves with flanges, P trap etc as per specifications.	1	LOT											
2.1.19	MONSOON REHEATING / WINTER HEATING KIT comprising strip heaters, safety controls, air-stat, contactors, frame work, thermostat & humidistat/ sensors etc.	1	LOT											
2.1.20	Electrode HUMIDIFIER for each AHU room complete with humidistat, safety controls, make up water piping from make up tank / nearest source of water, valves fittings etc	1	LOT											
2.1.21*	GSS zinc coating 180 gms/ m² ducting complete with hangers/ supports, dampers, grilles, diffusers (with & without VCD) etc.													
2.1.21.1*	18G.	1250	SQM*											
2.1.21.2*	20G.	2250	SQM*											
2.1.21.3*	22G.	2750	SQM*											
2.1.21.4*	24G.	4250	SQM*											
2.1.22*	Thermal insulation of supply air duct & return air duct with finish as specified.	1251	SQM*											
2.1.23*	Fire damper.													
2.1.23.1*	Fire damper with auto resetting, limit switches, indication lamps etc.	25	SQM*											
2.1.23.2*	Motorized actuator with single phase power supply for the above fire damper.	37	NO*											
2.1.24	Grills / Diffusers / Acoustic lining of duct/ Volume control dampers etc for all the AC Plants													
2.1.24.1*	SUPPLY AIR DIFFUSERS / GRILLS with VCD (Extruded Aluminium powder coated) complete with fixing frames, nuts, bolts, gaskets, washers etc	60	SQM*											
2.1.24.2*	RETURN AIR DIFFUSERS / GRILLS without VCD (Extruded Aluminium powder coated) complete with fixing frames, nuts, bolts, gaskets, washers etc	90	SQM*											
2.1.24.3*	VOLUME CONTROL DAMPERS in GI construction as per specifications for supply / return ducts complete with fixing arrangement.	40	SQM*											
2.1.25	ACOUSTIC INSULATION of the first 6m of ducting from AHU outlets with material and finish as per specifications.	1	LOT											
2.1.26	FRESH AIR FANS (axial flow type), complete with motor, inlet cone, air filters (pre and fine), dampers, etc	1	LOT											
2.1.27	SMOKE FANS (axial flow type), complete with motor, inlet cone, air filters, dampers, etc	1	LOT											
2.1.28	Common PLC BASED CONTROL SYSTEM for AC system - AC Pant-1,2 and Ventilation system (for Air washer & UAF only) with Hot redundant PLC consisting of PLC Panels including local panel / push button stations for AHU room, RIO Panel etc, OWS, Key board, I/O modules, I/O adapter modules, Furniture for PLC (as required), power supply, UPS, Battery and Battery Charger, printer, WAN connectivity etc as specified as per tender specification	1	LOT											
2.1.29	FIELD INSTRUMENTS like pressure gauge, temperature gauge, pressure switch, differential pressure switch, flow switch, flow meter, and other instrument required for PLC control etc	1	LOT											
2.1.30*	Fibre optic Cable with its accessories from I/O Panel / Racks to Main PLC Panel of AC & Ventilation System	2000	Mtr*											
2.2	AC plant-2 (ESP Control Room Building)													
2.2.1	Water Cooled Precision AC 40TR(Net) with suitable static pressure and complete with all accessories as specified	2	NO											
2.2.2	Booster PUMPS sets for condenser water recirculation complete with TEFC motor & all accessories as specified.	2	NO											
2.2.3	CONDENSER WATER PIPING with necessary fittings like tees, reducers, expanders, elbows, flanges, all types of valves with flanges, strainers with flanges, air vents etc as per specifications. This item shall cover the entire condenser water piping (pipe, valves, strainers and all supporting accessories).	1	LOT											
2.2.4	MS medium class DRAIN WATER PIPING from various equipment like cooling tower (including equalising line), condenser water pumps etc upto nearest available drain point with necessary fittings like tees, reducers, expanders, elbows, flanges, valves with flanges, P trap etc as per specifications.	1	LOT											
2.2.5	Non Chemical Treatment Equipment	1	LOT											
2.2.6	ACOUSTIC INSULATION of the first 6m of ducting from AHU outlets with material and finish as per specifications.													
2.2.7	FRESH AIR FANS (axial flow type), complete with motor, inlet cone, air filters (pre and fine), dampers, etc	1	LOT											

B-SCH NO	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY	UNIT	SUPPLY					ERECTION & COMMISSIONING					
				Unit Price (Rs)	Total ex-works price (Rs)	ED including CESS (Rs)	CST / VAT (Rs)	FREIGHT including Service Tax, if applicable (Rs)	TOTAL F.O.R. Site Price Supply (Rs)	Unit Price (Rs)	Total Price (Rs)	Service Tax (Rs)	Total Price (Erection & Commissioning) including Service Tax)	Total Price Supply FOR Site and E & C including service tax (Rs)
2.3	AC plant-3 (Administrative Building and Other areas)													
2.3.1*	Air Cooled Package AC 15TR(Net) complete with all accessories as specified	8	NO*											
2.3.2*	Air Cooled Package AC 10TR(Net) complete with all accessories as specified	2	NO*											
2.3.3	MS medium class INSULATED DRAIN WATER PIPING from various equipment like AHUs (including equalising line), FCUs, chilled water pumps etc upto nearest available drain point with necessary fittings like tees, reducers, expanders, elbows, flanges, valves with flanges, P trap etc as per specifications.	1	LOT											
2.3.4	MONSOON REHEATING / WINTER HEATING KIT comprising strip heaters, safety controls, air-stat, contactors, frame work, thermostat & humidistat/ sensors etc.	1	LOT											
2.3.5	Electrode HUMIDIFIER for each AHU room complete with humidistat, safety controls, make up water piping from make up tank / nearest source of water, valves fittings etc	1	LOT											
2.3.6	Fresh Air System as specified in the specification	1	LOT											
2.3.7	ACOUSTIC INSULATION of the first 6m of ducting from PAC outlets with material and finish as per specifications.													
2.4	Air conditioning system for aux control rooms as specified.													
2.4.1	Air-cooled split type AC units consisting of condensing unit & evaporating unit including refrigerant pipes & fittings with insulation etc. (Minimum BEE Rating 4 Star for Non-Ductable Split AC)													
2.4.1.1*	5.0 TR capacity (ductable type, 415 V, 3 phase with isolation switch).	2	NO*											
2.4.1.2*	2.0 TR capacity (non-ductable type, 240 V, 1 phase isolation switch) with isolation switch , i.e MCB of suitable rating as specified.	65	NO*											
2.4.1.3*	1.5 TR capacity (non-ductable type, 240 V, 1 phase isolation switch) with isolation switch , i.e MCB of suitable rating as specified.	30	NO*											
2.5*	Handling Arrangement for AC Equipments													
2.5.1*	3T Electric Hoist with monorail arrangement for AC Plant	1	NO*											
2.5.2*	Manually operated, platform trolley of 1 Ton capacity with base area 2m x 1.5m	3	NO*											
2.6	Total lumpsum price for commissioning spares inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT											
2.7	Total lumpsum price for special tools & tackles for maintenance inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT											
2.8	Total lumpsum price for Mandatory Spare for air conditioning inclusive of packing forwarding, transportation up to site, etc. (Bidder to submit item-wise price break-up seperately).	1	LOT											
2.8.1	Total lumpsum price for Mandatory Spare for air conditioning inclusive of packing forwarding, transportation up to site, etc. as per ANNEXURE-II A OF TECHNICAL SPECIFICATION PE-TS-410-553-A001 for MECHANICAL ITEMS (Bidder to submit item-wise price break-up seperately).	1	LOT											
2.8.2	Total lumpsum price for Mandatory Spare for air conditioning inclusive of packing forwarding, transportation up to site, etc. as per ANNEXURE-II B OF TECHNICAL SPECIFICATION PE-TS-410-553-A001 for C&I ITEMS (Bidder to submit item-wise price break-up seperately).	1	LOT											
2.8.3	Total lumpsum price for Mandatory Spare for air conditioning inclusive of packing forwarding, transportation up to site, etc. as per ANNEXURE-II C OF TECHNICAL SPECIFICATION PE-TS-410-553-A001 for ELECTRICAL ITEMS (Bidder to submit item-wise price break-up seperately).	1	LOT											
2.8.4	Total lumpsum price for Mandatory Spare for air conditioning inclusive of packing forwarding, transportation up to site, etc. as per ANNEXURE-II D OF TECHNICAL SPECIFICATION PE-TS-410-553-A001 for MATERIAL HANDLING ITEMS (Bidder to submit item-wise price break-up seperately).	1	LOT											

NOTES

- The bidder shall furnish unit rates for variable item (marked *) i.e., ducting, supply grilles (with and without VCD), fire damper, thermal insulation for ducting for all the AC Plants, Package AC, Split AC Units, FCUs etc for necessary adjustment (plus or minus) variation during detailed engg. stage. The unit rates quoted above shall be considered and no separate unit rates shall be quoted. Unit rates shall be valid throughout the contract. Final qty. shall be paid as per actual measurement at site for supply as well as erection for all the variable items.
- Bidder must submit prices in the Pro Forma duly filled in signed and stamped on every page without any ambiguity. The price shall be written against each item. Term such as "refer covering letter" etc. are not acceptable. Extra sheet may be attached if the space provided is not sufficient
- Price format shall not be changed by the bidder as the bidder may get disqualified by doing so.
- Any other item not indicated above, but required to complete AC system as per system requirements.
- For limitation on payment, percentages of individual items/equipments, as specified in the appendix-A2 shall be applicable

APPENDIX - A2 Percentage breakup for Air Conditioning Package 1x800 MW KOTHAGUDEM TPS		
SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	Percentage of total price
1	Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duty packed for transportation, delivery to site, unloading storage & handling at site, erection & commissioning, carrying out acceptance tests at site, final painting and handing over to customer the complete AC system on turnkey basis for 1X800 MW KOTHAGUDEM as per specification PE-TS-410-553-A001 including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc.(Without mandatory spare - Sr. No. 8 of suggestive price format)	100%
2.0	BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE (To be used during contract execution for payment)	
2.1	Total lump sum firm price for EQUIPMENT (SUPPLY) for Engineering, design, manufacture, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duly packed for transportation, delivery to site, unloading storage & handling at site, for the complete scope of supply of AC system as defined in the technical specification (PE-TS-410-554-A001) for 1X800 MW KOTHAGUDEM including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc..	80%
2.2	Erection & commissioning, carrying out acceptance tests at site, final painting and handing over to customer the complete AC system on turnkey basis as per specification PE-TS-410-554-A001 including all taxes, duties etc..	20%
3.0	Break-up (%) of prices given at SI No-2.0 above (To be used during contract execution for payment)	Percentage of total price of SL No 2.0 above
3.1	Water Chilling machine - Screw Chiller - (Item no 2.1.1 of Suggestive price format)	19.00%
3.2	Air handling units (Item Nos 2.1.2 to 2.1.7 of Suggestive price format)	8.50%
3.3	Cooling Towers (Item no 2.1.8 of Suggestive price format)	2.00%
3.4	Pumps and FCU (Item no 2.1.9, 2.1.10, 2.1.11, 2.2.2 of Suggestive price format)	2.00%
3.5	Tanks (Item Nos 2.1.12, 2.1.13 of Suggestive price format)	1.00%
3.6	Water treatment equipment (Item no 2.1.14, 2.2.5 of Suggestive price format)	1.00%
3.7	Condenser water piping (Item no 2.1.15, 2.2.3 of Suggestive price format)	6.50%
3.8	Chilled & Drain water piping (Item no 2.1.16, 2.1.17, 2.1.18, 2.2.4 of Suggestive price format)	8.50%
3.9	Heaters and humidifiers (Item no 2.1.19, 2.1.20, 2.3.4, 2.3.5 of Suggestive price format)	3.00%
3.10	Fire Dampers (Item no 2.1.23 of Suggestive price format)	1.00%
3.11	GSS Duct work with airline accessories (Item no 2.1.21 of Suggestive price format)	9.50%
3.12	Acoustic insulation (Item no 2.1.25, 2.2.6, 2.3.7 of Suggestive price format)	1.00%
3.13	Thermal Insulation (Item no 2.1.22 of Suggestive price format)	8.50%
3.14	Grills/ Diffuser & VCD (Item no 2.1.24 of Suggestive price format)	1.00%
3.15	Fans (Item no 2.1.26, 2.1.27, 2.2.7, 2.3.6 of Suggestive price format)	1.00%
3.16	PLC including cable (Item no 2.1.28, 2.1.30 of Suggestive price format)	9.00%
3.17	Field instruments - (Item no 2.1.32 of Suggestive price format)	3.50%
3.18	water cooled Precision AC - (Item no 2.2.1 of Suggestive price format)	6.00%
3.19	Air cooled non-ductable split units (Item no 2.3.1, 2.3.2,2.4.1.1, 2.4.1.2, 2.4.1.3 of Suggestive price format)	6.00%
3.20	Handling Arrangment (Item no 2.5 of Suggestive price format)	1.00%
3.21	Commissioning Spares, Tools tackels & any other item (Item no 2.6, 2.7 of Suggestive price format)	1.00%

WVEK KUMAR
 SA Khan Praveen Kishore

1x800 MW KOTHAGUDEM
Air Conditioning System
GUARANTEED POWER CONSUMPTION FIGURES

S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY			
1	2	3A	3B	4	5	6=3Ax4x5
1.0	AC PLANT FOR MAIN CONTROL ROOM AREAS AND SERVICE BUILDING					
1.1	Screw Chiller	1	1			
1.2	AHU for MCR	2	0			
1.3	AHU for at 8.5 M level	2	0			
1.4	AHU for Service Building	10	0			
1.5	FRP Cooling Tower	1	1			
1.6	Condenser water pumps	1	1			
1.7	Chilled water pumps	1	1			
1.8	Fresh air fans for above AHU room.	7	0			
1.9	Smoke fan for AHU room	2	0			
2.0	ESP Control Room AC PLANT-2					
2.1	Water Cooled Condensing unit AC 40TR for ESP 12	2	1			
2.2	Booster Condenser Pump	1	1			
2.3	Fresh air fans for above PAC room.	1	0			
2.4	Smoke fan for PAC Room	1	0			
				TOTAL (KW)		659

Note:	Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as 659 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 @ Rs. 200000 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 @ Rs. 200000 per additional KW shall be levied on vendor.


 Praveen Kishore
 VIVEK KUMAR SA KHAN



TECHNICAL SPECIFICATION
1X800 MW KOTHAGUDEM
AIR-CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-410-553-A001

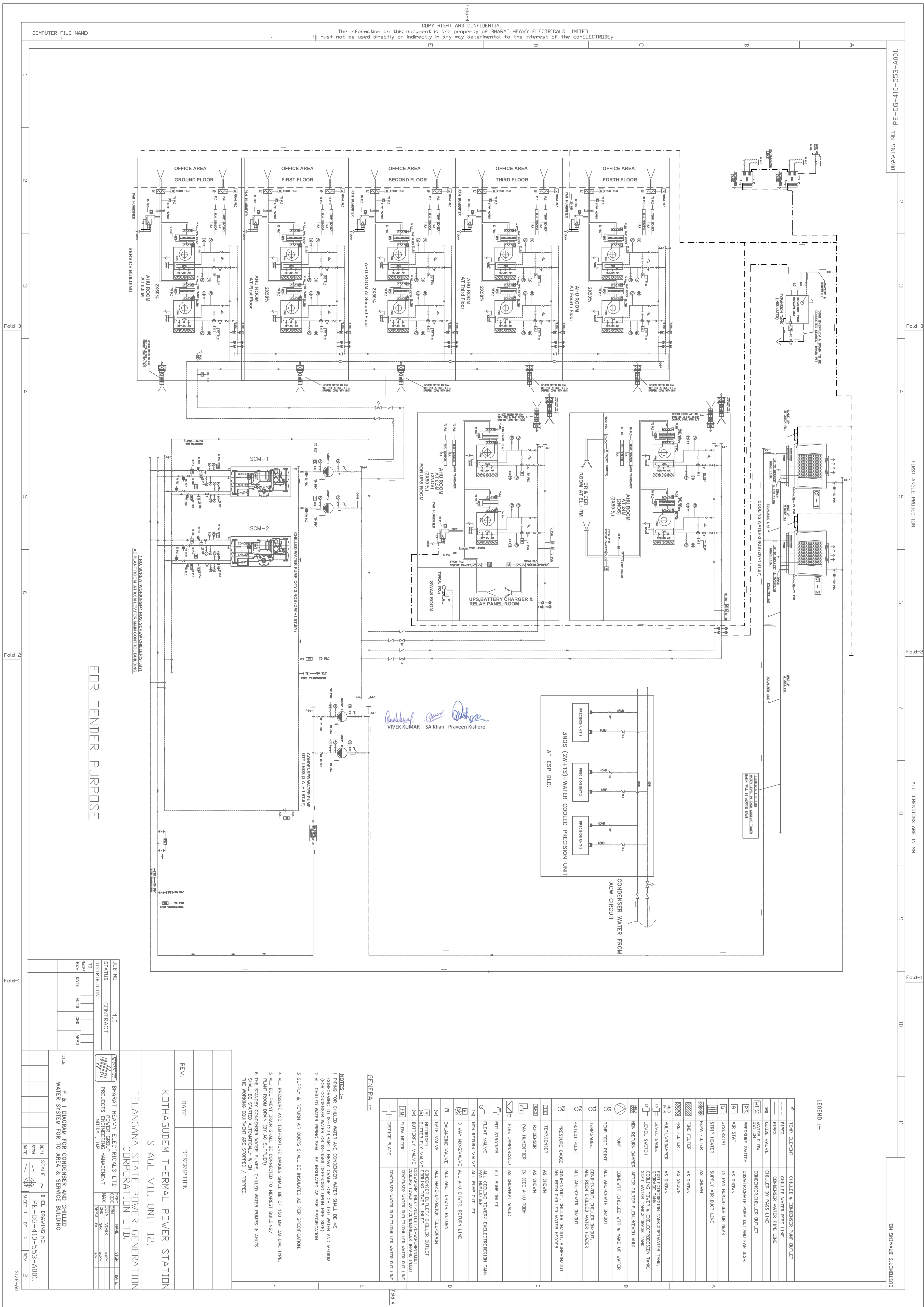
VOLUME III

REV. 00

DATE: MARCH 2015

LIST OF TENDER DRAWING


VIVEK KUMAR
SA Khan Praveen Kishore





REFERENCE DRUGS:

NOTES:—

- FOR DETAILS REFER ELECTRICAL DRAWING.

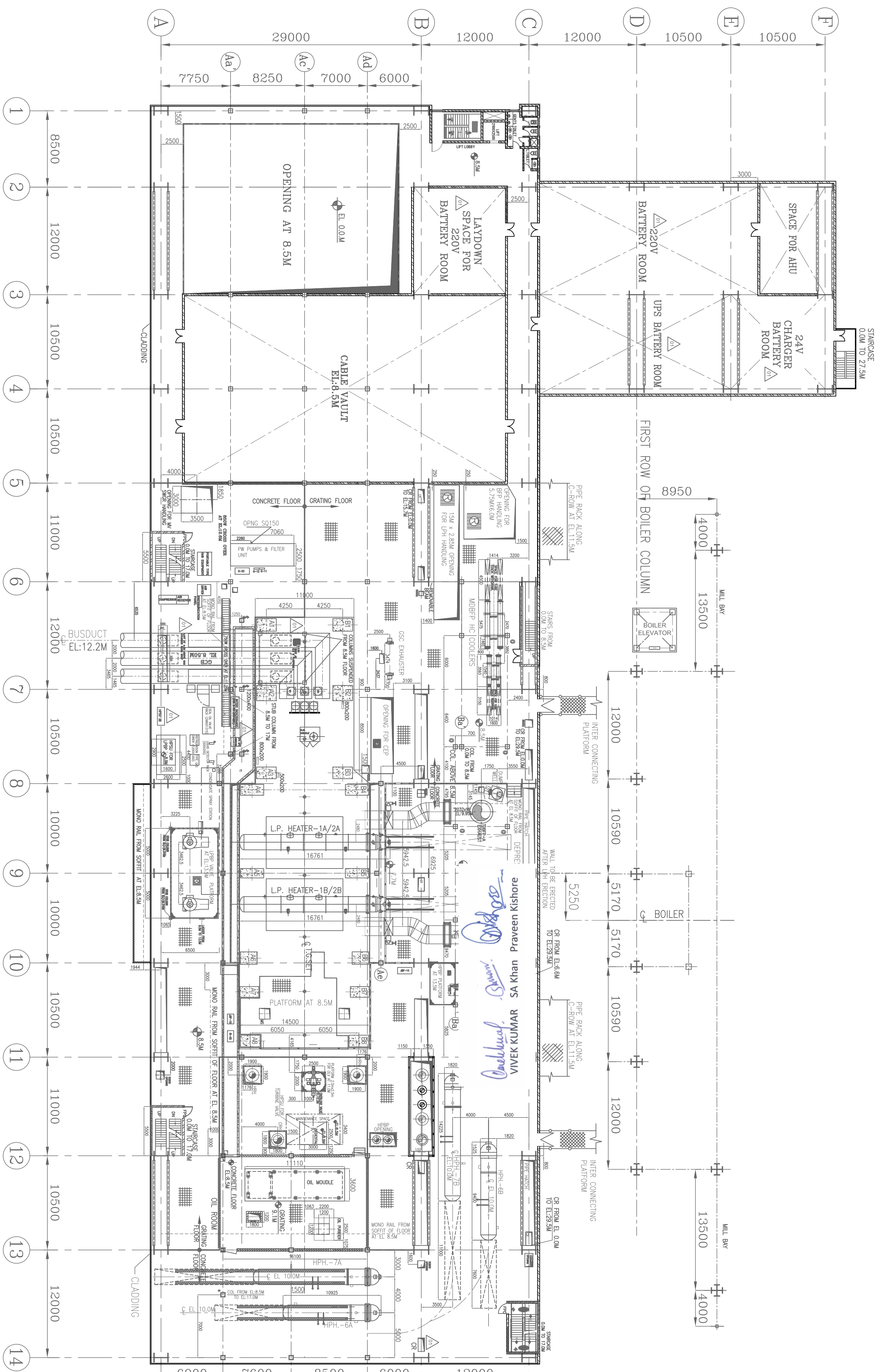
CIVIL TO NOTE:

LEGENDS	
	PIPE HATCH
	VERTICAL BRACING
	FPD
	FIRE PROOF DOOR
	GRATING
	CHUCKERD PLATE
	REMOVABLE
	HAND RAILING
	CABLE TRAY
	FIRE BRIGER WALL
	INDICATES PRESS/CABLE TESTILE
	RAIL TRACK
	RAIL SHUTTER
	PIPE (CHECK WITH P&ID COVERED SANI FILL)

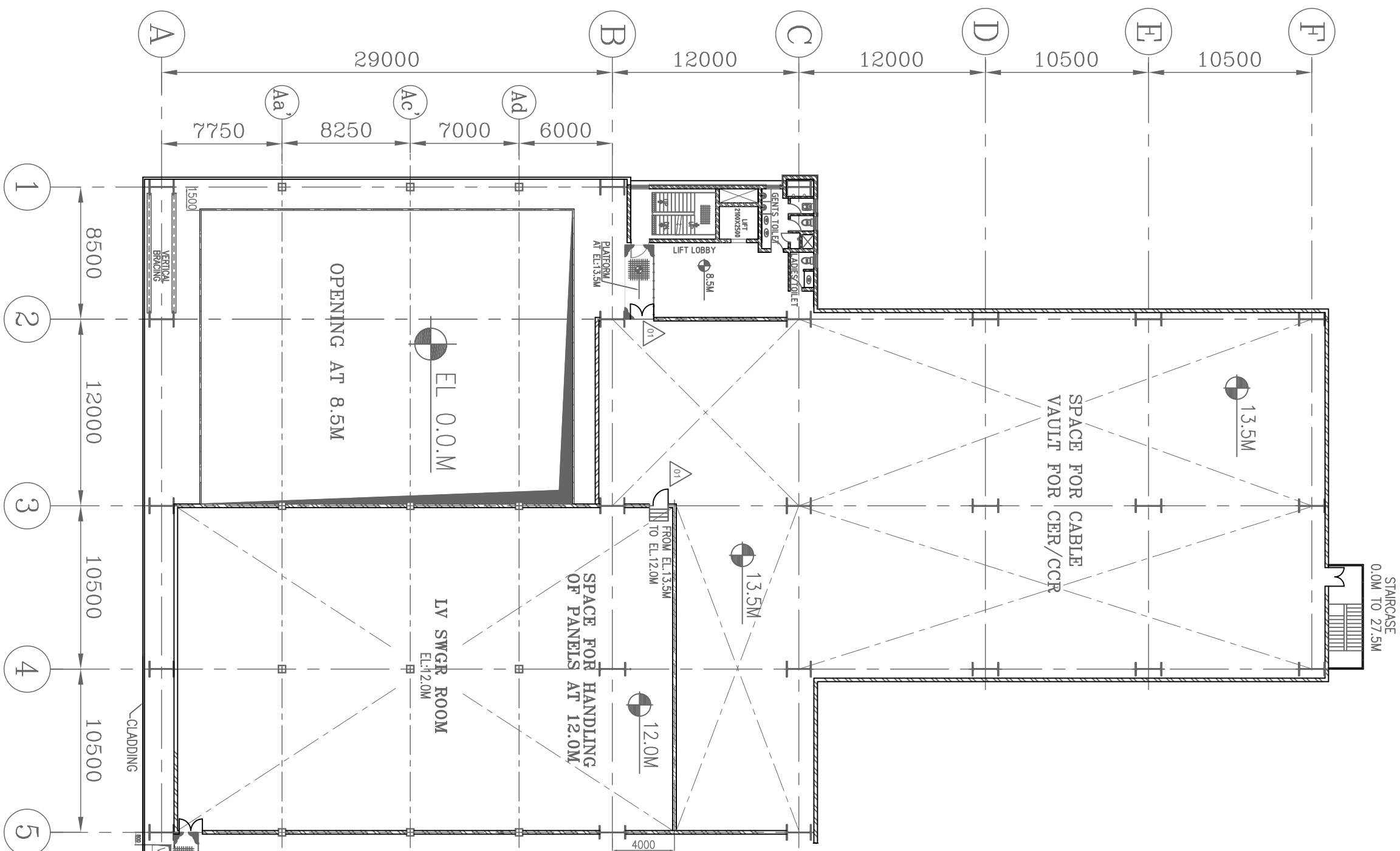
JOB NO.	410
STATUS	CONTRACT
DISTRIBUTION	



BHARAT HEAVY ELECTRICALS LTD
 POWER SECTOR
 PROJECT ENGINEERING MANAGEMENT
 Noida



PLAN AT EL. 7.7/8.5M



PLAN AT EL. 12.0M/13.5M

CIVIL TO NOTE:
* COLUMN UPTO EL.8.5M
\$ COLUMN FROM 0.0 TO ~13.5(BOTTOM OF OIL CANAL)
COLUMN UPTO EL.2.5M
© COLUMN UPTO BOTTOM OF BFP DECK

REFERENCE DRGS:

SL NO	TITLE	NUMBER	UNIT
1	TG EQUIPMENT PLAN AT EL. 0.0 M	PE-0C-410-100-M003	PEM
2	TG EQUIPMENT PLAN AT EL. 7.0 M	PE-0C-410-100-M005	PEM
3	TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS IN BC BAY	PE-0C-410-100-M006	PEM
4	TG HALL CROSS SECTION	PE-0C-410-100-M007	PEM
5	OIL ROOM ARRANGEMENT	---	HMR
6	LP ROOM ARRANGEMENT	---	HMR
7	OIL CANAL FOUNDATION PLAN	---	HMR
8	CA LP HEATER 1A / 2A & 1B / 2B	---	HMR
9	CA HP HEATER 6A	---	HMO
10	CA HP HEATER 6B	---	HMO
11	CA HP HEATER 7A	---	HMO
12	CA HP HEATER 7B	---	HMR
13	HPSU FOR TURBINE VALVE	---	HMR
14	CA OF MDRFP HC COOLERS	---	HMO
15	CA OF OLV	---	HMR/SIG
16	CA OF HP BP VALVE	---	TRY
17	TURBINE JB LIST & LAYOUT	---	HMR
18	TDBFP LUBE OIL EQUIPMENT LAYOUT	---	HMO
19	HPSU FOR LPB	---	HMR
20	LAYOUT OF LV SWGR ROOM	PE-0C-410-100-E003	PEM ELECT

NOTES:-

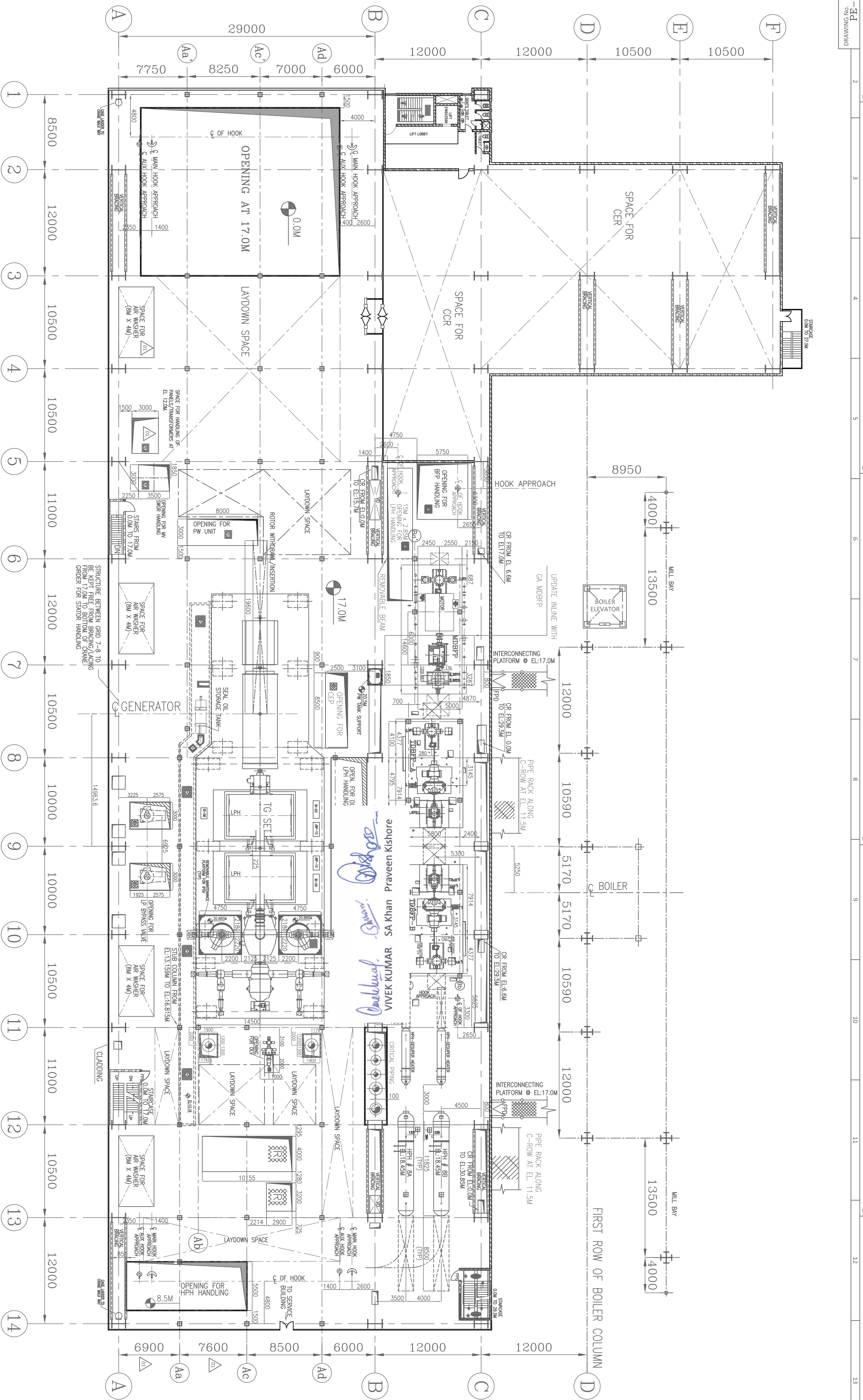
- ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
 - ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL. 0.00M WHICH CORRESPONDS TO RL. 99.5M.
 - CABLE DUCT/TRENCH/SILT LAYOUT IS SHOWN FOR REPRESENTATION PURPOSE ONLY.
- FOR DETAILS REFER ELECTRICAL DRAWING.

LEGENDS

---	PPE HATCH
---	VERTICAL BRACING
---	FIRE PROOF DOOR
---	GRATING
---	CHEQUERED PLATE
---	REMOVABLE
---	HAND RAILING
---	CABLE TRAY
---	FIRE BARRIER WALL
---	INDICATES PIPES/CABLE TRUSTLE
---	ROLLING SHUTTER
---	RAIL TRACK
---	INDICATES PIPES/CABLE TRUSTLE
---	INDICATES PIPES/CABLE TRUSTLE
---	INDICATES PIPES/CABLE TRUSTLE
---	WALK WAY
---	CONCRETE

REFERENCE DRGS:		
Sl NO	TITLE	UNIT
1	TG EQUIPMENT PLAN AT EL. 0.0 M	PEU
2	TG EQUIPMENT PLAN AT EL. 8.5 M	PEU
3	TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS IN BC BAY	PEU
4	T.G. CROSS SECTION	PEU
5	CA OF MOBP	PEU
6	CA OF TOBP	HNO
7	CA OF HP HEATER BA	HNO
8	CA OF HP HEATER BB	HNO
9	CA OF RESUPERHEATER	HNO
10	TG DECK FOUNDATION PLAN	HNO
11	LAYOUT OF GENERATOR COMPONENTS	HNO
12	LAYOUT OF TURBINE COMPONENTS	SAG
13	FOUNDATION ARRANGEMENT FOR SPV AND DRIVE TURBINE	HNO
14	FOUNDATION OF MOBP	HNO
15	OIL CANAL FOUNDATION PLAN	HNO
16	REMOVABLE MAINTENANCE PLATFORM FOR PSV	HNO

LEGENDS	
	PIPE HATCH
	VERTICAL BRACING
	FIRE PROOF DOOR
	GRATING
	CHECKERED PLATE
	REMOVABLE
	HAND RAILING
	CABLE TRAY
	FIRE BARRIER WALL
	INDICATES PIPES/CABLE TRESTLE
	ROLLING SHUTTER
	RAIL TRACK
	PIPE TRENCH WITH RCC BRICK WALL AND FILLED
	INDICATES PIPES/CABLE TRESTLE
	BUS DUCT
	WALK WAY
	CONCRETE



PLAN AT EL.17.0M

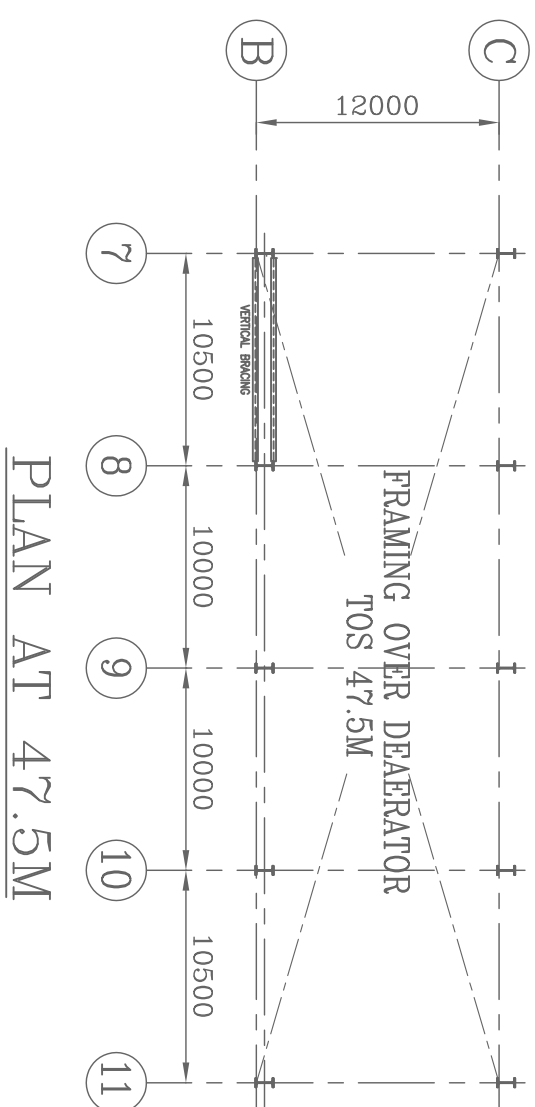
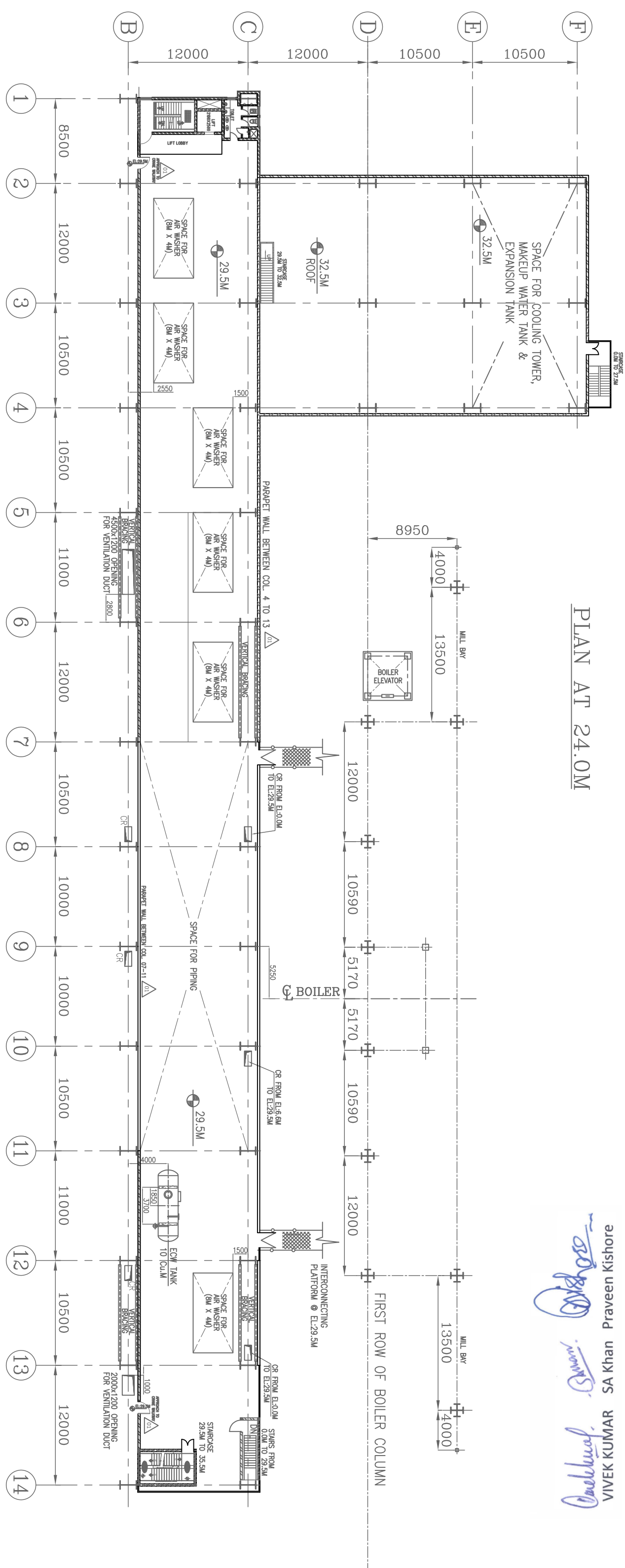
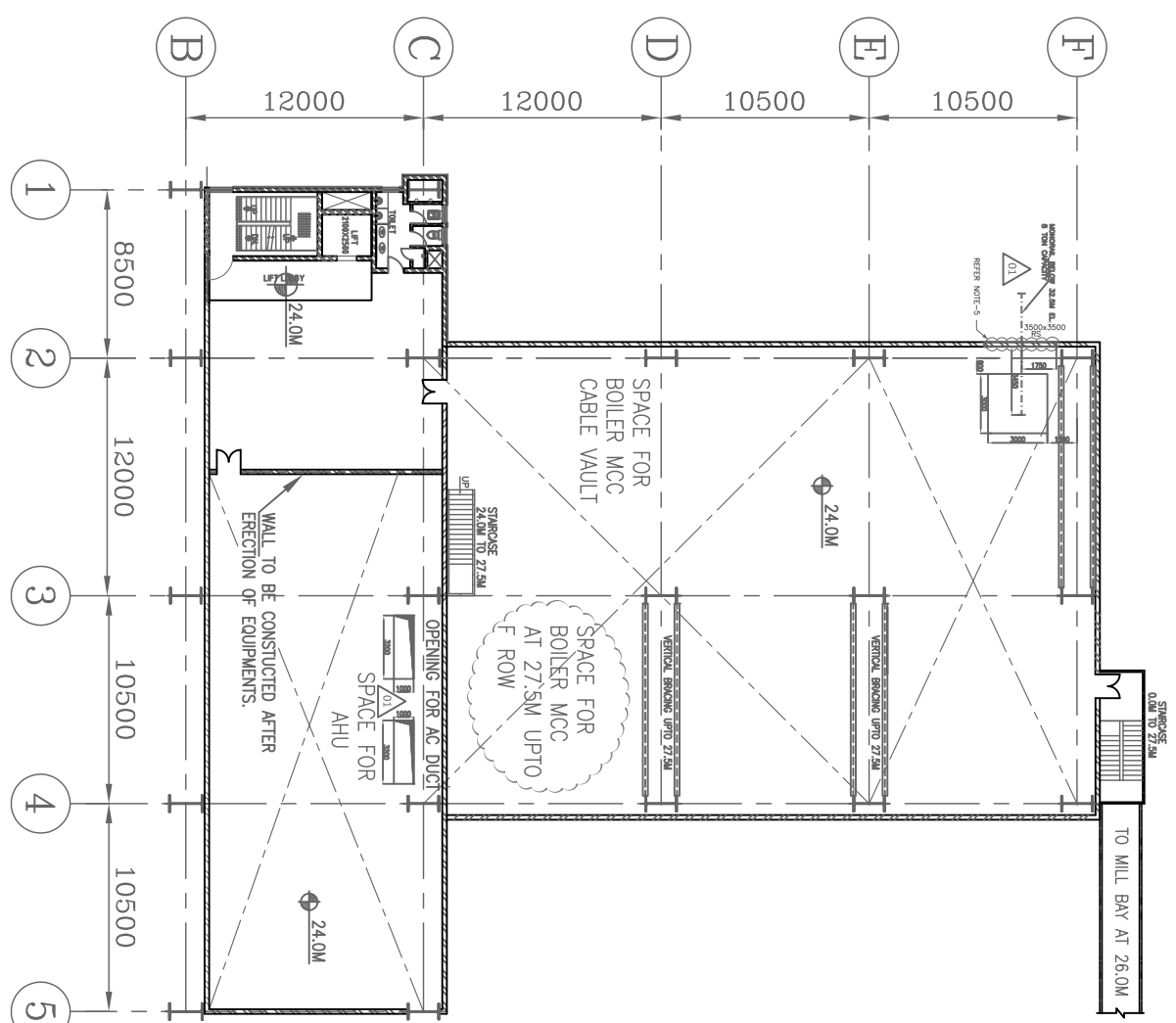
DETAIL OF LAY-DOWN SPACE FOR TG COMPONENTS

Sl No	DESCRIPTION	W.T.N T	AREA M x M
01	HP SHUT	20.0	5.5 X 1.5
02	EXHAUST CANAL	20.0	3.4 X 3.3
03	INNER COOLING PIPES PART	17.0	3.4 X 3.3
04	HP SHUT	40.0	6.52 X 1.7
05	TURBINE COOLING PIPES PART	30.0	5.5 X 1.5
06	HP SHUT	30.0	5.5 X 1.5
07	HP SHUT	30.0	5.5 X 1.5
08	HP SHUT	30.0	5.5 X 1.5
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99	HP SHUT	30.0	5.5 X 1.5
100	HP SHUT	30.0	5.5 X 1.5

- NOTES:-
1. ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
 2. ALL ELEVATION MARKED ARE W.R.T. TO HALL FINISHED FLOOR ELEVATION OF EL. 0.00M WHICH CORRESPONDS TO RL 99.5M.
 3. CABLE DUCT/TRENCH/SILT LAYOUT IS SHOWN FOR REPRESENTATION PURPOSE ONLY.
- FOR DETAILS REFER ELECTRICAL DRAWING.

REV	DATE	AUTO	QID	APPD	REV	DATE	AUTO	QID	APPD
1	01/01/2022				2	01/01/2022			
3	01/01/2022				4	01/01/2022			
5	01/01/2022				6	01/01/2022			
7	01/01/2022				8	01/01/2022			
9	01/01/2022				10	01/01/2022			
11	01/01/2022				12	01/01/2022			
13	01/01/2022				14	01/01/2022			
15	01/01/2022				16	01/01/2022			
17	01/01/2022				18	01/01/2022			
19	01/01/2022				20	01/01/2022			
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53	01/01/2022				54	01/01/2022			
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97	01/01/2022				98	01/01/2022			
99	01/01/2022				100	01/01/2022			

CUSTOMER		CONSULTANT		PROJECT ENGINEER	
TELANGANA STATE POWER GENERATION CORPORATION LTD		BHARAT HEAVY ELECTRICALS LTD		PROJECT ENGINEER	
TELANGANA STATE, INDIA		KOLATA, MUMBAI, CHENNAI, NEW DELHI		PROJECT ENGINEER	
16800 MM KOTHRUDAM TTS SHED-III UNIT#12, PALOCHA		BHARAT HEAVY ELECTRICALS LTD		PROJECT ENGINEER	
DEVELOPMENT CONSULTANTS PVT. LTD.		BHARAT HEAVY ELECTRICALS LTD		PROJECT ENGINEER	
CONSULTING ENGINEERS		BHARAT HEAVY ELECTRICALS LTD		PROJECT ENGINEER	
KOLATA, MUMBAI, CHENNAI, NEW DELHI		BHARAT HEAVY ELECTRICALS LTD		PROJECT ENGINEER	
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PROJECT ENGINEER		BHARAT HEAVY ELECTRICALS LTD		PROJECT ENGINEER	
PROJECT ENGINEER		BHARAT HEAVY			



		
VIVEK KUMAR	SA KHAN	Praveen Kishore

PLAN AT 24.0M

PLAN AT 29.5M

NOTES:-

1. ALL DIMENSION ARE IN MM AND LEVELS ARE IN METERS.
 2. ALL ELEVATION MARKED ARE W.R.T. TO HALL FINISHED FLOOR ELEVATION OF EL. 0.00M WHICH CORRESPONDS TO RL 99.5M.
 3. CABLE DUCT/TRENCH/SILT LAYOUT IS SHOWN FOR REPRESENTATION PURPOSE ONLY. FOR DETAILS REFER ELECTRICAL DRAWING.
 4. DETAILS FOR AIR WASHER ARE INDICATIVE.
 5. WALL ON HOLD AND THE SAME SHALL BE CONSTRUCTED AFTER ERECTION OF PANEL/SWGR.
- COLUMNS UPTO 47.5M FOR B-ROW & UPTO 50.0M FOR C-ROW.

LEGENDS	
	PRE INCH
	FINE THREAD
	1/2 INCH
	3/4 INCH
	1 INCH
	1 1/2 INCH
	2 INCH
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	32 INCH
	32 1/2 INCH
	33 INCH

REFERENCE DRAWINGS:		
SL No	TITLE	DWG. NUMBER
1	TO EQUIPMENT PLAN AT EL. 0.0 M	PE-05-410-100-M003
2	TO EQUIPMENT PLAN AT EL. 8.5 M	PE-05-410-100-M004
3	TO EQUIPMENT PLAN AT 17.0 M	PE-05-410-100-M005
4	T.O. HALL CROSS SECTION	PE-05-410-100-M007
5	GA. OF DEGRADATION	HY-05-1-16310-84901
6	GA. OF PORTABLE WATER TANK	---
7	GA. OF FCW TANK	---
8	GA. AIR WASHER LAOUT	---
9	GA. MOOT TANK / SKID	PEM
10	GA. D/A PLATFORM	---
		HYD

REFERENCE DRAWINGS:					
SL No	TITLE	DWG. NUMBER	UNIT		
1	TC EQUIPMENT PLAN AT EL. 0.0 M	Pt-06-410-100-M003	PEM		
2	TE EQUIPMENT PLAN AT EL. 8.5 M	Pt-06-410-100-M004	PEM		
3	TO EQUIPMENT PLAN AT 17.0 M	Pt-06-410-100-M005	PEM		
4	T6. HALL CROSS SECTION	Pt-06-410-100-M007	PEM		
5	GA OF DEAEATOR	Ht-06-1-16316-B4901	HND		
6	GA OF PORTABLE WATER TANK	----	BPL		
7	GA OF ECW TANK	----	BPL		
8	GA AIR WASHER LAYOUT	----	PEM		
9	GA MOOT TANK / SMD	----	PEM		
10	GA D/A PLATFORM	----	HND		

FRAMING OVER DEAEERATOR
TOS 47.5M

10000 10000 10500

⑧ ⑨ ⑩ ⑪

PLAN AT 47.5M

ENSION ARE IN MM AND LEVELS ARE IN METRES.

ATION MARKED ARE W.R.T TO HALL FINISHED FLOOR ELEVATION OF EL 0.00M WHICH CORRESPONDS TO RL 99.5M.

UCT/FRENCH/SUIT LAYOUT IS SHOWN FOR REPRESENTATION PURPOSE ONLY. FOR DETAILS REFER ELECTRICAL DRAWING.

FOR AIR WASHER ARE INDICATIVE.

HOLD AND THE SAME SHALL BE CONSTRUCTED AFTER ERECTION OF PANEL/SWR.

UPTO 47.5M FOR B-R/W & UPTO 50.0M FOR C-R/W.

SEE COMMENTS OF HARD COPY

CUSTOMER: 	TELANGANA STATE POWER GENERATION CORPORATION LTD. TELANGANA STATE, HYDRABAD
OWNER'S CONSULTANT: 	1x800 MW KOTHAGUDAM TPS STAGE-III UNIT#2, PALONKHA DISTRICT, TELANGANA DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA MUMBAI CHENNAI NEW DELHI BHARAT HEAVY ELECTRICALS LTD PROJECT ENGINEERING MANAGEMENT NODIA
JOB NO. 410	
STATUS CONTRACT	
DISTRIBUTION	

SEE COMMENTS OF HARD COPY

	COAL INDIA LIMITED TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA STATE, INDIA 18800 MW KOTHAGUDAM TPS STAGE-VII UNIT#12, PALONCHA
OWNER'S CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD.

BHARAT HEAVY ELECTRICALS LTD. POWER SECTOR PROJECT ENGINEERING MANAGEMENT INDIA	CONSOLIDATING ENGINEERING KOLKATA MUMBAI CHENNAI NEW DELHI

TITLE	COPY RIGHT AND CONFIDENTIAL			
	The information on this document is the property of			
	BHAU HEAVY ELECTRICALS LIMITED. It must not be used directly or			
	indirectly in any way that is to the interest of the company.			
	N			
TITLE	TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS			
	ABOVE OPERATING FLOOR IN BC BAY			
	DATE	SCALE	SHEET	NO.
	08/07	1:10	001	04
	08/07	1:10	001	04
TITLE	TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS			
	ABOVE OPERATING FLOOR IN BC BAY			
	DATE	SCALE	SHEET	NO.
	08/07	1:10	001	04
	08/07	1:10	001	04

[illegible]

FIRST ANGLE PROJECTION

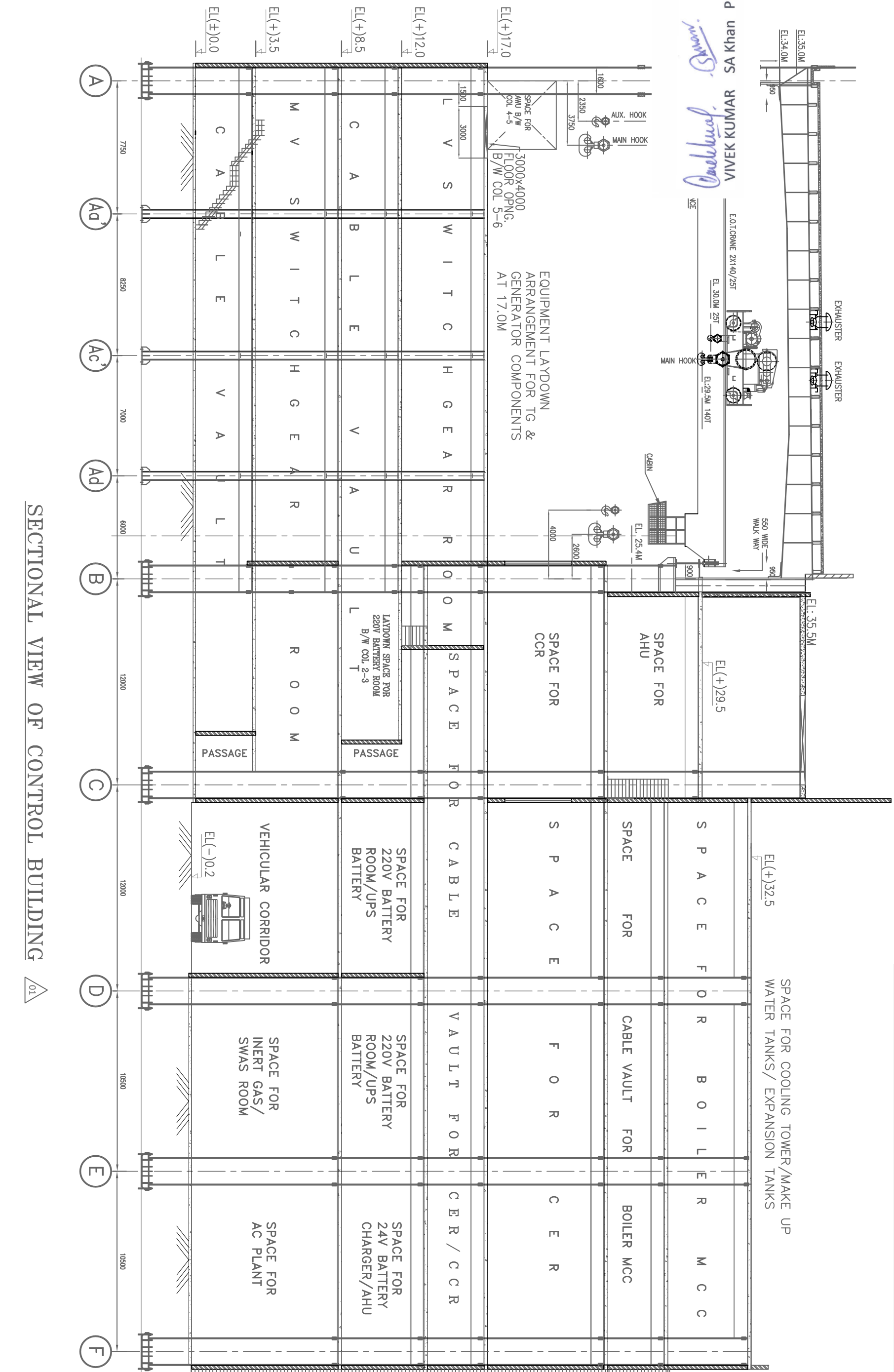
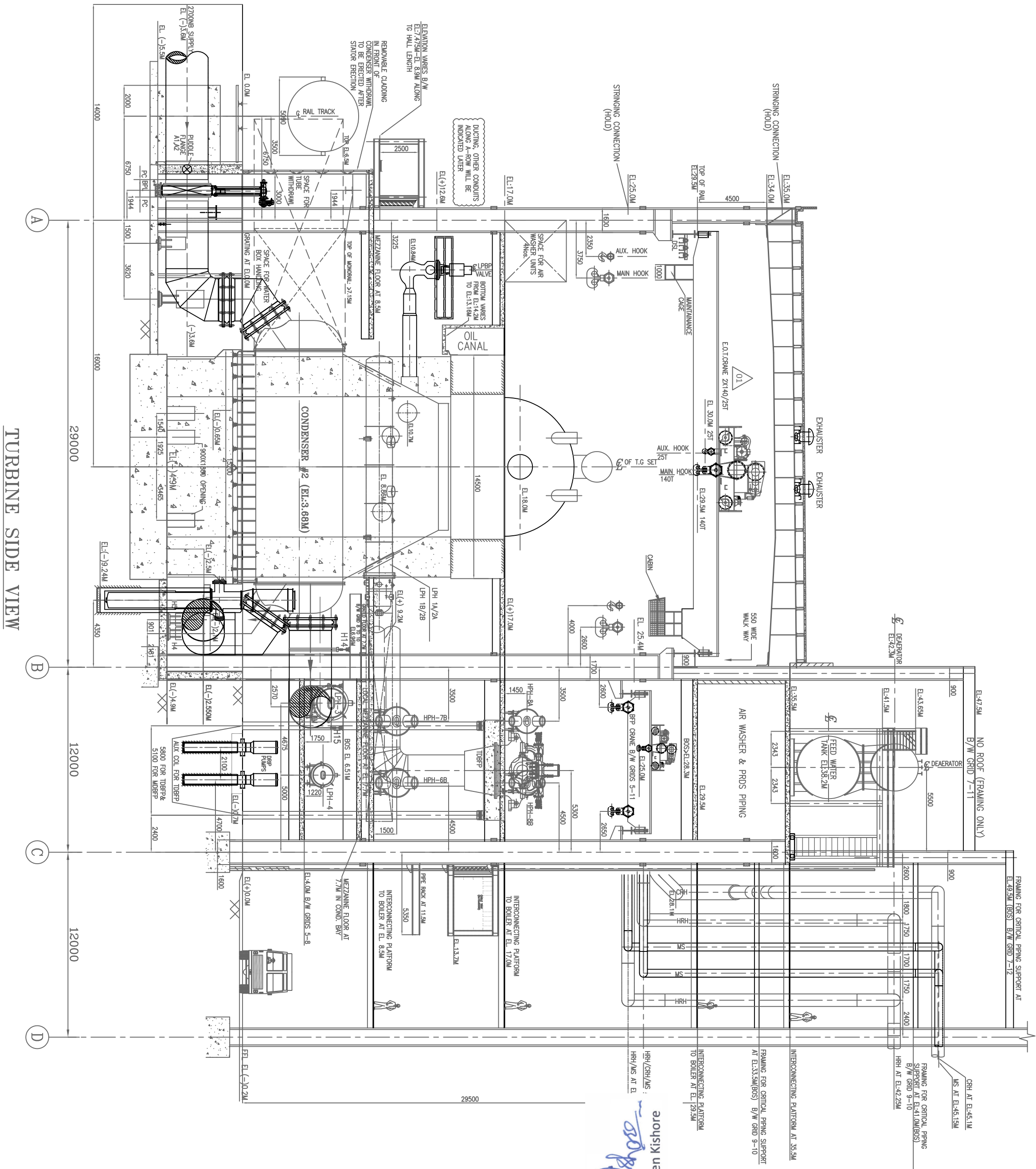
ALL DIMENSIONS ARE IN MM

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09.06.2015

LEGENDS	
	VERTICAL BRACING
	FIRE PROOF DOOR
	GRATING
	CHEQUERED PLATE
	REMOVABLE
	HAND RAILING
	FIRE BARRIER WALL

REFERENCE DROGS:		
SL. NO	TITLE	UNIT
1	TO EQUIPMENT PLAN AT EL.0.0 M	FE-00-410-100-M003
2	TO EQUIPMENT PLAN AT EL.8.5 M	FE-00-410-100-M004
3	TO EQUIPMENT PLAN AT EL.17.0 M	FE-00-410-100-M005
4	TO EQUIPMENT PLAN AT MISCELLANEOUS FLOORS IN BC BAY	FE-00-410-100-M006



NOTES:-

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METERS.
2. ALL ELEVATION MARKED ARE W.R.T. TO HALL FINISHED FLOOR ELEVATION OF EL. 0.0M WHICH CORRESPONDS TO RL 99.3M.
3. ALL THE SIZES AND LOCATION OF COLUMNS OR TO BECK ARE SUBJECT TO FINALIZATION AFTER THE DESIGN.
4. SIZES OF ALL THE BUILDING MAIN AND AUXILIARY COLUMNS ARE SUBJECT TO CIVIL DESIGN.
5. OTHER DETAILS ARE INDICATIVE.

CUSTOMER:	TELANGANA STATE POWER GENERATION CORPORATION LTD
OWNER'S CONSULTANT:	TELANGANA STATE, INDIA
DEVELOPMENT CONSULTANTS PVT. LTD.	1x800 MW KOTHAGODAM TPS STAGE-VII UNIT#12, PALONCHA
CONSULTING ENGINEERS	KOLKAIA MUMBAI CHENNAI NEW DELHI
BHARAT HEAVY ELECTRICALS LTD	POWER SECTOR
PROJECT ENGINEERING MANAGEMENT	NOWDA

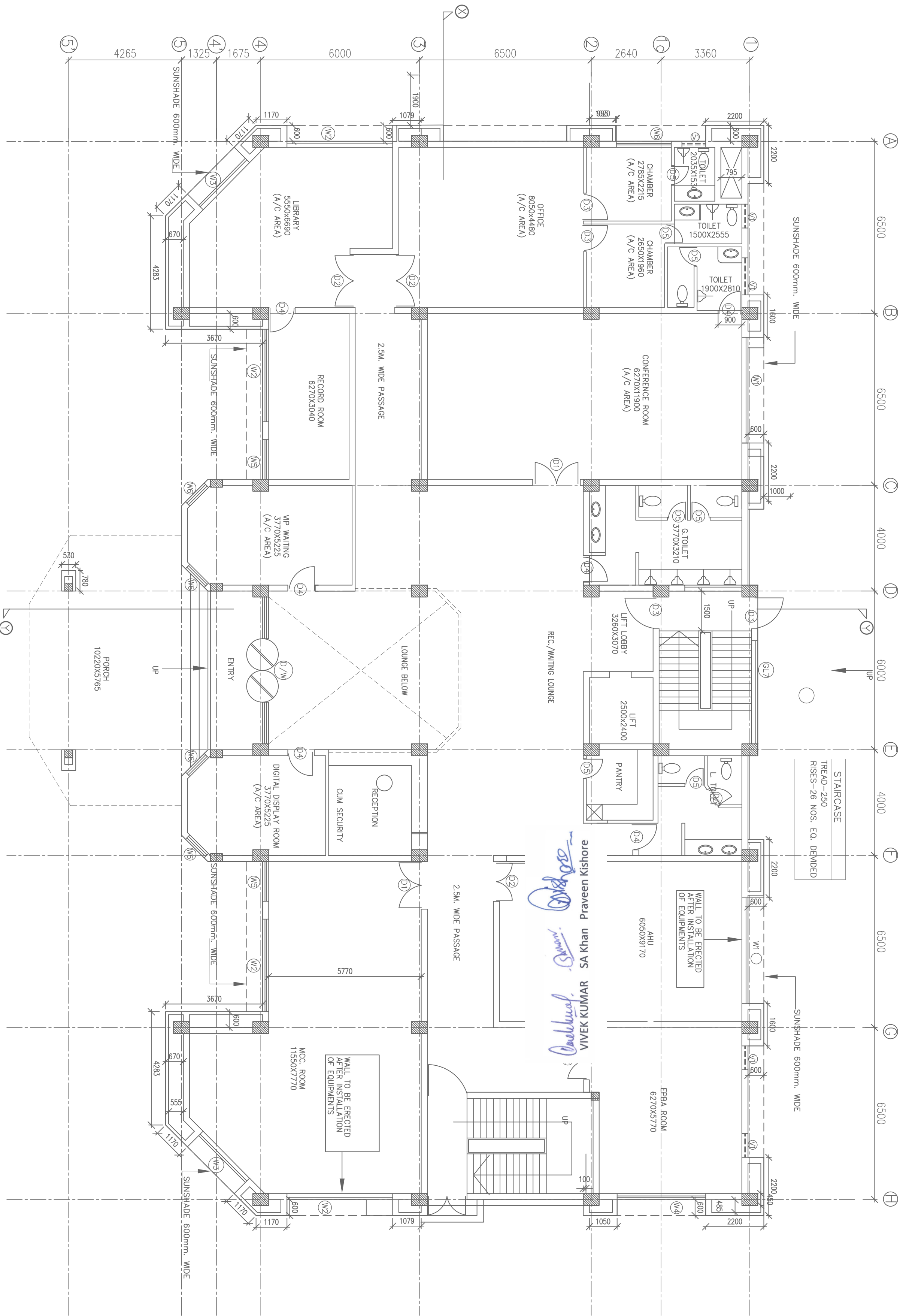
COPY RIGHT AND CONFIDENTIAL			
TO	DATE	CHD	APPD
REV	DATE	CHD	APPD
01	17.03.2015	PK	GSF
02	20.02.2015		PK

CROSS SECTION OF MAIN PLANT (TG BUILDING)			
DEPT.	SCALE	DRAWING NO.	PE-DG-410-100-M007
SIGN	DATE	SHEET	1 OF 1
REV	DATE	REV	00

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COMPUTER FILE NAME: 410_100_M007_R0

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LEVEL AT ± 0.00 M.
AREA-834.50+61.8/2
SQM.

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD

JOB NO.	410
STATUS	CONTRACT
DISTRIBUTION	
PRINT SCALE IN METRE	0 20 30 40 50



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

	NAME	SIGN	DATE
DRN	RAJENDRA		
DESN	SHRIKANT		
CHD	ANIL		
APPD	SACHIN		

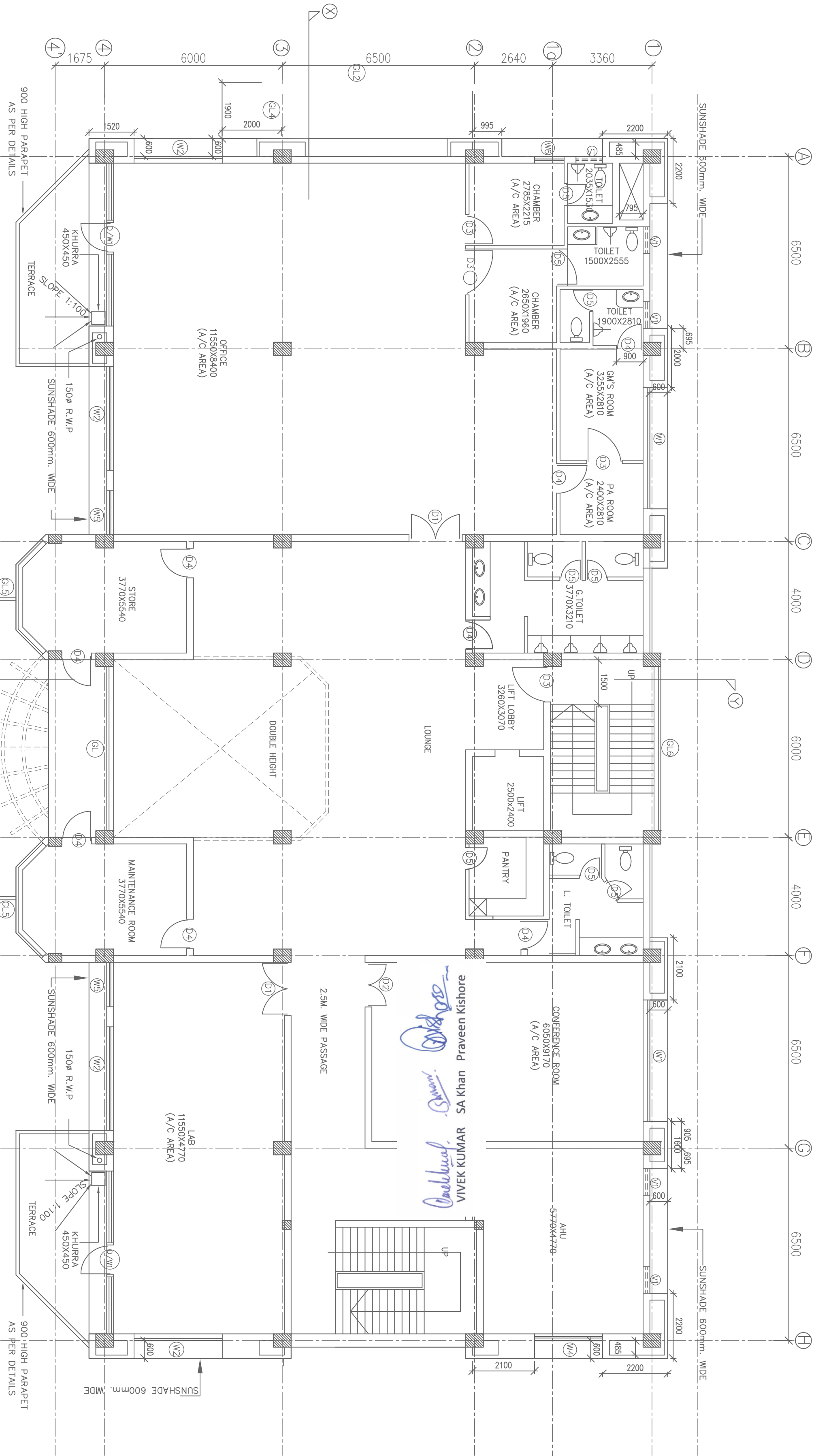
KOTHAGUDEM THERMAL POWER STATION
STAGE-VII, UNIT # 12 (1X800 MW)



TELANGANA STATE POWER GENERATION CORPORATION LTD.
HYDERABAD
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA MUMBAI CHENNAI NEW DELHI

BHEL-PROJECT ENGINEERING MANAGEMENT(CIVIL)	
THIS DRAWING MARKED(✓) IS RELEASED FOR	
☐ COMMENTS/APPROVAL	
☐ PLANNING/INFORMATION	
☐ CONSTRUCTION	
STAMP ALL PREVIOUS REVISION AS SUPERSEDED	
NAME	ISSUED BY
SIGNATURE	ANIL KHANDLWAL
DATE	26 February 2015

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LEVEL AT +4.25 M.
AREA-792.50 SQM.

JOB NO.	410
STATUS	CONTRACT
DISTRIBUTION	
PRINT SCALE IN METRE	
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PROJECT	KOTHAGUDEM THERMAL POWER STATION					
	STAGE-VII, UNIT # 12 (1X800 MW)					
	BHARAT HEAVY ELECTRICALS LTD					
	POWER SECTOR					
	PROJECT ENGINEERING MANAGEMENT					
	NEW DELHI					
	DEPT	NAME	SIGN	DATE		
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	DESN	SIRKANT				
	CMD	ANIL				
	APPD	SACHIN				

BHEL-PROJECT ENGINEERING MANAGEMENT(CIVIL)	
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☐ PLANNING/INFORMATION	
☐ CONSTRUCTION	
STAMP ALL PREVIOUS REVISION AS SUPERSEDED	
NAME	ANIL KHANDLWAL
SIGNATURE	
DATE	26 February 2015

CUSTOMER
TELANGANA STATE POWER GENERATION CORPORATION LTD.
HYDERABAD

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA MUMBAI CHENNAI NEW DELHI



SERVICE BUILDING
ARCHITECTURAL PLAN AT +4.25M.

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD
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7					6					5				
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MPL	ELEC	C&I	MSE	MAX	DEPT.	SCALE	DRAWING NO.
					SIGN		PE-DG-410-640-C002
					DATE		
					SHEET	1 OF 1	REV. 0

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it must not be used directly or indirectly in any way detrimental to the interest of the company.

LEVEL AT +8.50 M.
AREA-792.50 SQM.

TITLE									
SERVICE BUILDING									
ARCHITECTURAL PLAN AT +8.50M.									
DRAWING NO.									
PE-DG-410-640-C003									
SHEET 1 OF 1 REV 0									

JOB NO.	410	PROJECT	KOTHAGUDEM THERMAL POWER STATION			
STATUS	CONTRACT		STAGE-VII, UNIT # 12 (1X800 MW)			
DISTRIBUTION						
			BHARAT HEAVY ELECTRICALS LTD			
			POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI			
DEPT CODE	C	NAME	SIGN	DATE		
DESIGN	RAJENDRA					
DESIGN	SHRIKANT					
CADD	ANIL					
APPD	SACHIN					

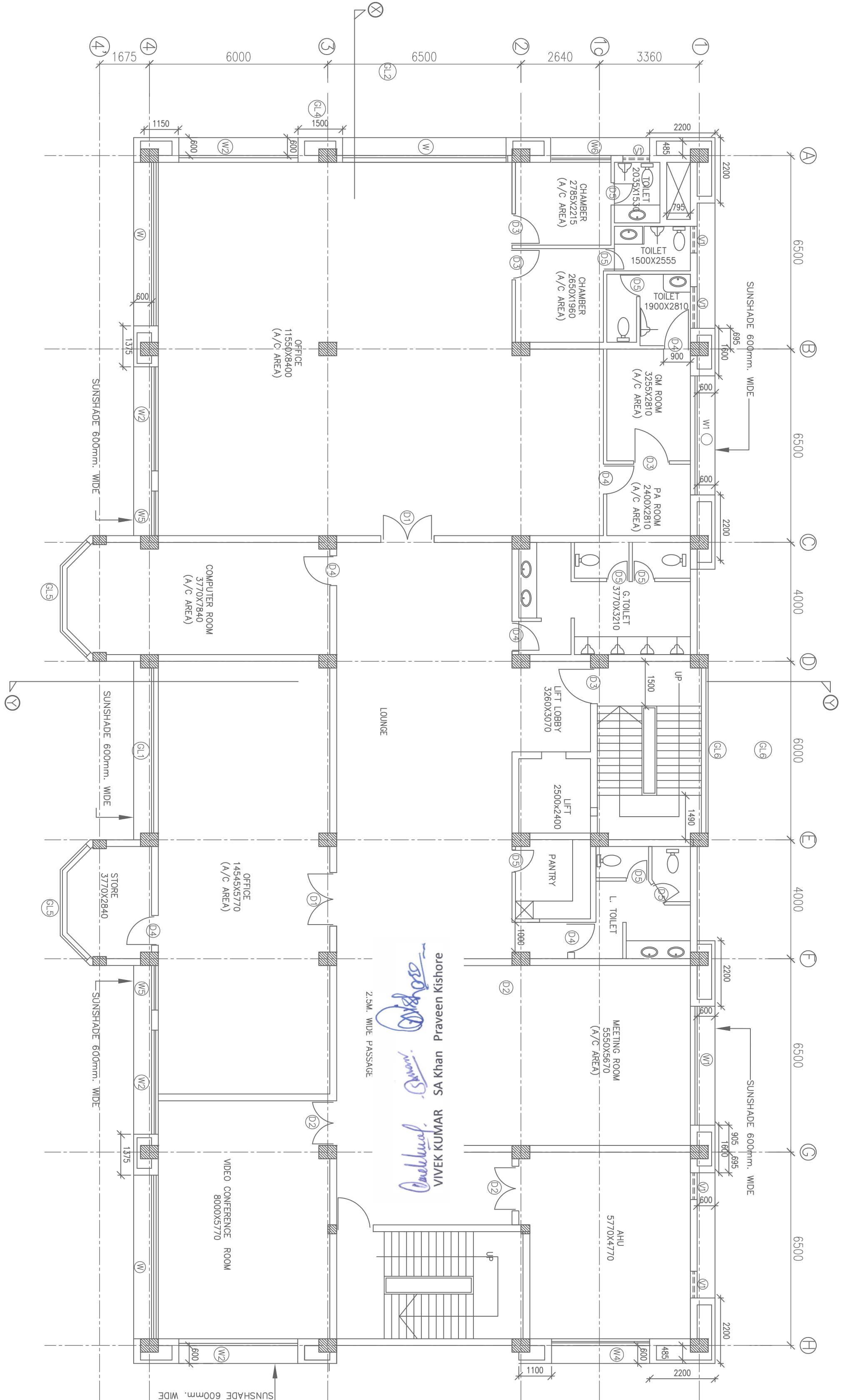
BHEL-PROJECT ENGINEERING MANAGEMENT(CIVIL)	
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ISSUED BY	
NAME	ANIL KHANDUWAL
SIGNATURE	
DATE	26 February 2015

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Fold-2

Fold 1

FORMAT SIZE A1



LEVEL AT +12.75 M.
AREA-792.50 SQM.

BHEL-PROJECT ENGINEERING MANAGEMENT(CIVIL)	
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☐ PLANNING/INFORMATION	
☐ CONSTRUCTION	
STAMP ALL PREVIOUS REVISION AS SUPERSEDED	
NAME	ANIL KHANDELWAL
SIGNATURE	
DATE	26 February 2015

JOB NO.	410
STATUS	CONTRACT
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PRINT SCALE IN METRE	
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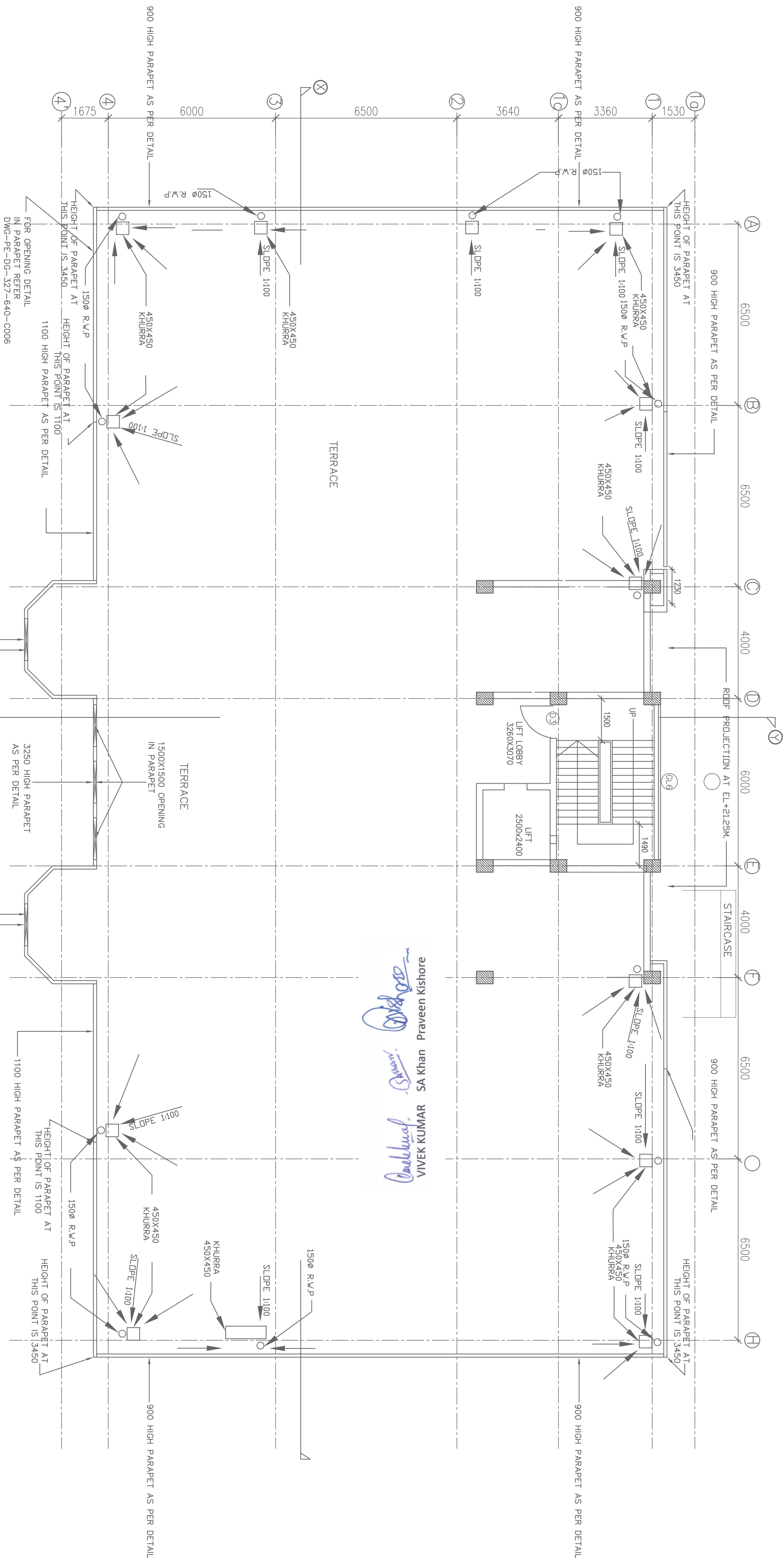
CUSTOMER	TELANGANA STATE POWER GENERATION CORPORATION LTD.
HYDERABAD	
CONSULTANT	DEVELOPMENT CONSULTANTS PVT. LTD.
KOLKATA MUMBAI CHENNAI NEW DELHI	
PROJECT	KOTHAGUDEM THERMAL POWER STATION
STARGE-VII, UNIT # 12 (1X800 MW)	

BHARAT HEAVY ELECTRICALS LTD	DEPT	DRN	NAME	SIGN	DATE
POWER SECTOR	CODE	RAJENDRA			
PROJECT ENGINEERING MANAGEMENT	CHD	SHRIKANT			
NEW DELHI	APPD	SACHIN			

TITLE	SERVICE BUILDING
ARCHITECTURAL PLAN AT +4.25M.	

REV.	DATE	CHD	APPD	REV.	DATE	CHD	APPD	REV.	DATE	CHD	APPD	REV.	DATE	CHD	APPD
10				9				8				7			
6				5				4							

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ROOF LEVEL AT +21.25M.
TERRACE AREA-522 SQM.
COVERED AREA-97 SQM.

JOB NO.	410
STATUS	CONTRACT
DISTRIBUTION	
PRINT SCALE IN METRE	0 20 30 40 50

PROJECT	KOTHAGUDEM THERMAL POWER STATION			
	STAGE-VII, UNIT # 12 (1X800 MW)			
	BHARAT HEAVY ELECTRICALS LTD			
	POWER SECTOR			
	PROJECT ENGINEERING MANAGEMENT NEW DELHI			
	DEPT CODE	NAME	SIGN	DATE
	DRN RAJENDRA			
	CHD SHIKHANT			
	APPD SACHIN			

BHEL-PROJECT ENGINEERING MANAGEMENT(CIVIL)		
THIS DRAWING MARKED ✓ IS RELEASED FOR		
☐ COMMENTS /APPROVAL		
☐ PLANNING /INFORMATION		
☐ CONSTRUCTION		
STAMP ALL PREVIOUS REVISION AS SUPERSEDED		
ISSUED BY		
NAME	ANIL KHANDELWAL	
SIGNATURE		
DATE	26 February 2015	

SERVICE BUILDING
ARCHITECTURAL PLAN AT ROOF

REV.	DATE	CHD	APPD	REV.	DATE	CHD	APPD	REV.	DATE	CHD	APPD	REV.	DATE	CHD	APPD
10				9				8				7			
6				5				4							

WPL	ELEC	C&I	MSE	MAX	DEPT. SCALE	DRAWING NO.	PE-DG-410-640-C006
					SIGN	SHEET	1 OF 1
					DATE	REV.	0

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