



भारत हेवी इलेक्ट्रिकल्स लिमिटेड
BHARAT HEAVY ELECTRICALS LIMITED

पारेषण व्यापार अभियांत्रिकी प्रबंधन

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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| | TYPE/ प्रकार OF DOC. | TECHNICAL SPECIFICATION | | | हस्ता. / SIGN | | | | |
| | TITLE/ शीर्षक | AC & VENTILATION SYSTEM (SWITCHYARD CONTROL BUILDING) | | | नाम / NAME | TDT | SKS | NSR | |
| | | | | | दिनांक/ DATE | 10-11-14 | 10-11-14 | 10-11-14 | |
| | | | | | समूह/GROUP | TBEM | W.O. No | 83001 | |
| | ग्राहक/ CUSTOMER | RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LIMITED (RRVUNL) | | | | | | | |
| | परियोजना/ PROJECT | 2 X 660 MW SURATGARGH TPS, UNIT 7 & 8, STAGE V – 400 KV SWITCHYARD | | | | | | | |
| | CONSULTANT | TATA CONSULTING ENGINEERS LTD. | | | | | | | |
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| | | | | | | | | | |
| | Rev No. | Date | Altered | Checked | Approved | REVISION DETAILS | | | |
| | Distribution | | | | To | TBEM | TBMM | TBQM | Vendor |
| | | | | | Copies | 1 | 1 | 1 | 4 |



SECTION -1

INTENT, SYSTEM DESCRIPTION, DESIGN CRITERIA AND SCOPE

1.0 INTENT OF SPECIFICATION

- 1.1 This specification covers the design, manufacture, inspection and testing at bidder's and/ or his sub vendor's work(s), proper packing, transportation & delivery, storage and handling at site, erection, testing and commissioning, final painting and carrying out acceptance tests at site of **Air-Conditioning and Ventilation System** as detailed in this section and in various other sections of this specification for **Switchyard Control building of 2x660MW Suratgarh-Unit 7 & 8 TPS- 400kV Switchyard** of Rajasthan Rajya Vidyut Utpadan Nigam Ltd (RRVUNL).
- 1.2 The requirement(s) specified under 'SECTION 2, SECTION 3, SECTION 4' and 'SECTION 5' of this spec. shall be considered as part of this section. In case of variance between sections, requirements of Section-1 shall prevail. Customer spec. enclosed shall be adhered to by the bidder.
- 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/ Owner, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgment is not in full accordance herewith.
- 1.4 The bidder shall be deemed to have understood completely all the tender drawings and documents and quoted accordingly.
- 1.5 The bidder has to note carefully the parameters, estimated capacities of equipment indicated and the tender drawing in the specification are only for guidance of the bidder. The system shall be designed as per relevant standards / codes and exact capacities and quantities are to be estimated by the bidder. All such estimations and design calculations shall be submitted for Purchaser's approval.
- 1.6 Deviation: In case of any deviation, the bidder shall indicate separately the deviations clause-wise with respect to the specification in the 'Schedule of Deviation' given in schedule 2 of section-5. Deviations in any other form including clarifications / assumptions / etc will not be considered and it will be construed that the bid conforms strictly to the specification.
- 1.7 The contract shall be on lump sum basis for the package. Within the scope of the contract no variation shall be admissible to the contractor so far the inputs remain unchanged. The Contractor shall be responsible for providing all material, equipment and services, specified or otherwise which are required to fulfill the intent of ensuring operability, maintainability and the reliability of the complete work covered under this specification. In case of change in the input after placement of order the additions / deletions to the scope shall be settled on the basis of mutually agreed rates.
- 1.8 The Purchaser, Consultant and Owner in this specification stand for BHEL, TCE and RRVUNL respectively. The successful bidder shall be referred to as Contractor.



2.0 HVAC REQUIREMENTS FOR VARIOUS AREAS

2.1.1.1 Air Conditioning for switchyard control building

Air-conditioning shall be provided to maintain the specified inside conditions for the following rooms in the building:

| Sl no. | Name of the Area | Dimensions of area (Sq. m) | AC Equipment | Equipment Capacity |
|--------|------------------------|----------------------------|---------------|--------------------|
| 1. | Control/ Relay room | 22 m x 21 m | PAC unit | 4 x 16.5TR |
| 2. | Conference room | 12 m x 7.5 m | | |
| 3. | AHU room | 10 m x 7.5 m | | |
| 4. | Shift Incharge room | 5.0 m x7.5 m | Split AC unit | 3 x 2TR |
| 5. | Library/ Record room | 4.5 m x 7.5 m | Split AC unit | 2 x 2TR |
| 6. | Electronic Test Lab | 4.5 m x 7.5 m | Split AC unit | 2 x 2TR |
| 7. | Engineers room | 12.0 m x7.0 m | Split AC unit | 4 x 2TR |
| 8. | Maintenance Staff room | 7.0 m x 6.0 m | Split AC unit | 2 x 2TR |
| 9. | Maintenance room | 7.0 m x 6.0 m | Split AC unit | 2 x 2TR |

2.1.1.2 4 nos. (3 working + 1 standby) of water cooled package AC units each of 16.5 TR capacity will be provided to cater the air conditioning requirement for the Control room & Conference room.

2.1.1.3 The packaged AC units shall be kept in AHU room where as cooling tower & condensing water pump shall be provided outside. Package unit, condenser water pump & the cooling tower are connected together by MS pipe of adequate size.

2.1.1.4 3 nos. (2 working+1 standby) of cooling tower & 3 nos. (2 working+1 standby) condenser water pump i.e. on 3 x 50% basis shall be provided for this packaged AC system.

2.1.1.5 Induced draft (single cell) FRP type shall consist of all accessories i.e. fan, motor, FRP basin, FRP louver, PVC eliminators nozzles, make up connection, drains overflow & piping, valves & fittings, strainer of brass wire mesh, ladder and supporting structure etc.

2.1.1.6 Non chemical online type water treatment plant shall be provided in makeup water connection to cooling towers to prevent scale formation in pipes and cooling towers.

2.1.1.7 Outlet of all the package units shall be collected in a common plenum chamber through flexible canvass connection & volume control dampers. The conditioned air is then distributed to various AC areas through supply air duct along with diffuser (with volume control damper) running above false ceiling. The return air from all these areas shall be collected above false ceiling & shall be taken back to the AHU room. The return air to AHU room will be mixed with a fixed amount of fresh air before being circulated again.

2.1.1.8 Non ductable AC split units shall be provided for these rooms as tabulated in Cl. No. 2.1.1.1 above.



2.1.1.9 Each AC split unit shall be complete with air-cooled outdoor condensing units having hermetically sealed reciprocating/rotary compressor and high wall type indoor evaporator unit with cordless remote controller, power cables, MCB with mounting box & first charge of refrigerant, refrigerant piping, insulation & PVC drain piping. Same shall be provided inline with its approved data sheet.

2.1.1.10 MS brackets, M.S. frame and fixing hardware like anchor bolts, nuts, fittings etc. as would be necessary for installation of split AC shall be provided by the contractor.

- **Bidder to submit heat load estimates & confirm the adequacy of the selected cooling capacity for maintaining inside conditions as prescribed in clause 2.1.2.1 of this specification.**

2.1.2.1 Design Criteria:

- Bidder shall fully satisfy himself of the air conditioning tonnage and plant sizing required to meet the following parameters, before submitting the tender. Following shall be considered while designing the system:

| Ambient Conditions | DB in °C | WB in °C |
|--------------------|----------|----------|
| Summer | 45 | 23.9 |
| Monsoon | 37.2 | 26.7 |
| Winter | 7.2 | 5 |

- Desired Inside condition

Dry Bulb Temperature: 22°C±1 °C

Relative Humidity: 50%±5% RH

- Floor Area – As per control building layout- TB-3-360-316-09 R3
- Exposed glass and exposed wall area - As per control building layout.- TB-3-360-316-09 R3
- Other details

| | | |
|-------------------------------------|-----|-----------------|
| Illumination Heat load | 2 | Watt per sq. ft |
| *Equipment heat load (Control room) | 7 | kW |
| Occupancy | 12 | people |
| Fresh Air requirement | 1.5 | ACPH |

- A design margin of 10% on grand total heat is considered while designing the AC Plant capacity for each area.



- ✓ Heat load for the individual rooms shall be furnished by the contractor during the detailed engineering stage. Monsoons reheat and winter heating calculations shall also be furnished in detail for approval.

2.1.1.11 SYSTEM DESCRIPTION

a. Piping & Valves:

i. Piping shall be

- ERW, black, IS-1239 heavy class for pipe sizes upto 150 NB.

ii. Isolating valves shall be butterfly valve for valve size 50 NB & above.

iii. Isolating valves shall be butterfly Gate valve for valve size below 50 NB.

iv. Strainers shall be Y- type.

v. Isolating valves shall be provided at the inlet & outlet piping of pumps, cooling towers & AHU's

vi. Non return valves shall be provided at the outlet of pumps.

- b. GSS duct shall be of lock forming grade, zinc coated conforming to IS: 277 with coating grade of 200 g/m². The ducting thickness shall be as follows:-

| Large side of rectangular duct/ diameter of circular duct (mm) | Gauge |
|--|-------|
| Up to 750 mm | 24G |
| From 751 to 1500 mm | 22G |
| From 1501 to 2250 mm | 20G |
| Above 2251 mm | 18G |

- c. Duct sizing and fabrication shall comply with requirements of IS 655. The air-distribution ducting shall be sized based on equal friction method to have an initial fan outlet velocity not exceeding 7.5 m/sec through the main ducts & 4 - 8 m/s for the branched ducts.
- d. The return air from all air conditioned areas shall be collected above false ceiling & shall be taken back to the AHU room through a duct connecting control room & AHU room where it will be mixed with a fixed amount of fresh air before being circulated again.
- e. Entire supply air ducts and return air duct shall be thermally insulated with 25 mm thick resin bonded fibre glass wool having density of 32 Kg /m³ backed with aluminium foil. Thermal insulation shall have thermal conductivity of 0.49 MW/ cm ° C at 50 ° C and shall conform to IS: 8183.
- f. Acoustic insulation of SA duct of 12 mm thick resin bonded fiberglass wool having density of 48 Kg/m³ covered with 30G perforated aluminum sheet cladding shall be provided on SA duct up to a length of 6 m from indoor unit outlet.
- g. R-407 shall be used as the refrigerant for package unit.
- h. Refrigerant piping shall be of copper tube as per ASTM B 280 standard.



- i. All the AC area which is exposed to the sunlight will be provided with underdeck insulation by BHEL.
- j. Necessary air balancing shall be achieved through volume control dampers in the ducts.
- k. Strip heater shall be provided in the common supply air plenum. The heater shall be suitably divided into different stages.
- l. One number pan type humidifier shall be kept in the AHU room for maintaining the required humidity level in the control building.
- m. The efficiency of pre-filters shall be 90% down to 20 microns and of fine filters shall be 99% down to 5 microns. The velocity across the pre filters shall be 1.75 m/sec and across fine filters shall be 1.25 m/sec respectively.
- n. Motorized fire dampers shall be provided in the supply air duct and in return air duct wherever duct crosses wall / slab opening in order to isolate the AHU room in the event of fire.
- o. 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.
- p. Suitable motorized dampers shall be provided for conference room to isolate this room from PAC system when not occupied/ in use.
- q. Fresh air unit complete with rain protection cowl, bird screen, pre and fine filters and volume control dampers shall be installed in the "AHU" room.
- r. Pressure gauges – Direct reading, pipe mounted dial type pressure gauges with 6 inch phenolic dial shall be provided at – One (1) each at suction & discharge of each pump set.
- s. Temperature gauges/ Stem type thermometer - Direct reading, field mounted 6 inch phenolic dial temperature gauge shall be provided at – One (1) each at condenser water inlet & outlet of each cooling tower.
- t. AHU room being at ground floor, a slab cutting of (2 x 2) m shall be provided suitably in the roof slab of AHU room to route the supply ducting/ return air to the control room.
- u. Return air wooden boxing shall be provided in Shift Incharge room (FF) just above the AHU room to accommodate supply air duct and also the return air between control room and AHU room.

2.1.1.12 CONTROL PHILOSOPHY

- Air conditioning system shall run round the clock.
- Room relative humidity shall be maintained by following means:
 - a. Heating through duct mounted strip heaters, which shall be operated by humidistat and thermostat.
 - b. Humidification through Pan Humidifier which shall be operated by humidistat.

The above controls shall be hard wired as per standard industry practice.



2.1.3.1 PROTECTION

Following protection shall be provided:

- a) Thermostat to cut off pan humidifier heater if temperature high
- b) Low water level interlock for pan humidifier.
- c) Thermostat to cut off strip heater if temperature is high.
- d) High pressure cut out (condensing the pressure).
- e) Low pressure cut out (evaporating pressure)
- f) Over load trip of compressor motor.
- g) Over load trip of blower fan motor
- h) Overload trip of condenser water pump motors
- i) Overload trip of cooling tower fan motor
- j) High temperature & "no Air flow cut out" with strip heaters.

2.1.3.2 INTERLOCKS

- i. The unit shall be started in the following sequence:
 - Blower fan of indoor unit.
 - Cooling tower fan
 - Condenser water pump
 - Compressors.
- ii. The compressor shall not start, if the following is not running
 - cooling tower fan
 - condenser water pump
 - blower
- iii. The duct heaters shall not start if neither of the blowers is working.
- iv. Pan humidifier heater to start only when water level in the humidifier tank is sufficient.
- v. AC system shall be tripped on signal from the Fire Alarm Panel.
- vi. Motorized fire dampers shall close on signal from Purchaser's Fire Alarm Panel.

2.1.3.3 ALARMS & ANNUNCIATIONS

Provision shall be made for 1 no. alarms/ annunciations panel in the control room for the following alarms:

- i. Water level low in Pan Humidifier.
- ii. Fire Damper Closed
- iii. Package Unit tripped
- iv. Low condenser water flow cut out
- v. Compressor tripped - for each compressor/ packaged unit.
- vi. Overload trip of condenser water pump motors.
- vii. Overload trip of cooling tower fan motor
- viii. Filter status for pre and fine filter



- ix. Failure of Pan Humidifier
- x. Control supply healthy/ failed (remote).
- xi. Trip on fire
- xii. Any other annunciation required to be considered during detailed engg. stage.
- xiii. Spare (as per RRVUNL spec.)

2.2.0 VENTILATION SYSTEM

- a) All the areas served by means of mechanical ventilation shall be designed for a maximum inside temperature of 3 deg. Celsius above the design ambient (DBT) condition during summer or according to suitable air changes per hour. The criterion that gives the highest flow rate will be considered for design & selection of the equipment.
- b) All the ventilation fans shall operate on 100% fresh air considering 25 air changes per hour (ACPH) for cable vault room & LT switchgear room, 30 ACPH for battery room and 20 ACPH for remaining rooms.
- c) Selection of size, rating & number of ventilation fans shall be done through proper calculation and the same shall be submitted for final approval during detailed engineering stage.
- d) Supply air fans with required static pressure & pre-filters to maintain positive pressurization shall be provided for the following rooms:
 - i. Cable Vault Room
 - ii. LT Switchgear Room
- e) Exhaust fans of suitable capacity (CMH) each having rain protection cowl, bird screen and mounting arrangement shall be envisaged for the following rooms:
 - i. Gents toilet (GF)
 - ii. Gents toilet (FF)
 - iii. Ladies toilet (FF)
 - iv. Pantry
 - v. Store Room
 - vi. Battery room - Motors for the fans of this room shall be flameproof with epoxy painting. These exhaust fans for shall be of bifurcated construction with motor away from the air stream. These fans shall have spark proof construction. Air intake shall be through louvers and fans for this room shall be provided on 2 x 50% basis.

✓ **Notes:**

- i. The impeller of the fans shall have blades of an airfoil design.
- ii. Ventilation fan calculation sheet and design criteria shall be submitted by contractor for customer/ Purchaser approval during detailed engineering stage.
- iii. Painting of all equipment and structures shall be provided. Colour & quality shall be subject to approval by the Client / Purchaser.



2.4.0 ELECTRICAL REQUIREMENTS

- a. One (1) no. MCC (contractor's scope) shall be provided for extending power supplies to packaged units, fresh air fan, heaters, solenoid operated fire dampers and pan humidifier. This panel will be located in AHU Room. Two nos. incomers, each of 300 Amps, 3 ph. 4 wire rating from the ACDBs will be provided by BHEL till air conditioning MCC which shall be terminated by the contractor. MCC shall have mechanical changeover switch for these incomers with castle key interlock. Spare feeders shall be provided in the MCC panel as per Cl. No. 2.0, Section D.9, Volume-IV- 415V Switchgear/ DB/ MCC specification of RRVUNL.
- b. MCC panel design criteria shall be as per the RRVUNL-Suratgarh TPS specification for Switchgear/ MCC.
- c. Power supply point for split AC units for individual rooms shall be in BHEL scope.
- d. All the ventilation fans will be fed from this MCC panel directly through single/ three phase MCBs.
- e. Local push button starters for fresh air fan and ventilation fans shall be provided. These starters shall be mounted just below the respective fans at a height of 1.5 m from the finished floor level.
- f. One (1) no. alarm/ annunciation panel shall be provided in the control room to take care of the various protections, alarms & annunciations. All the annunciation facia shall have provision for repeat facility.
- g. Control supply for alarm & annunciation panel in control room and 240V supply for space heating and panel illumination will be derived from the MCC itself.
- h. Interlocking shall be done with FAP to trip HVAC in case of fire.

2.4.0 Mandatory Spares

Items to be provided as mandatory spares for this system are:

| S.N. | Air Conditioning System | Ventilation System |
|------|----------------------------------|------------------------------------|
| 1. | One (1) set HP/LP cutout | One (1) set of fan bearings |
| 2. | One (1) set filters | One (1) set of fan motor bearings |
| 3. | One (1) no. expansion valve | One (1) motor for each size of fan |
| 4. | One (1) no. motor for compressor | |
| 5. | Induced draft cooling tower | |
| 5.a | Two (2) nos. fan impeller | |
| 5.b | Two (2) sets of spray nozzles | |

3.0.0 SCOPE

The requirement(s) mentioned under this clause are indicative and minimum for the system. Any other item / service required to complete the work for safe and sound operation of system shall be provided and installed by the bidder at no extra cost to the purchaser / owner. The bidder may bring out such requirement(s) suitably.



3.1.0 SCOPE OF SUPPLY

3.1.1 Complete supplies for Air-conditioning & Ventilation system (as per clause no. 2.0.0)

The equipments and services to be furnished under this contract are detailed here under for reference. Bidders shall work out the actual requirement based on the building layout enclosed with this specification. The items though not specifically mentioned but required for safe and satisfactory operation of the system will also be treated as included and the same shall be supplied at **NO EXTRA COST** to BHEL.

- i. 4 no. (3 working + 1 standby) Water cooled package units of 16.5 TR each complete with all components, pre-filters, controls, interlocking & other accessories.
- ii. First charge of refrigerant and oil.
- iii. One (1) lot of refrigerant piping, liquid line, discharge, suction valves as required.
- iv. 3 nos. (2 working + 1 standby) Induced draft, Fibre glass Reinforced Plastic (FRP) construction cooling towers each complete with all accessories i.e., Fan, motor, FRP basin, nozzles, make up connection, drains, piping, valves & fittings, strainers, ladder and supporting structure etc.
- v. 3 nos. (2 working + 1 standby) condenser water pump.
- vi. One (1) lot of water treatment plant.
- vii. One (1) lot of MS piping interconnecting package unit, cooling towers and pumps, complete with strainers, valves and fitting etc. There shall be dedicated piping for working and stand by AC system, suitably connected through valve for achieving better redundancy.
- viii. Gate valves - one each at suction and discharge side of the pump set.
- ix. One no. Y-Type strainer at inlet of each pump set complete with brass mesh screen, drain arrangement etc.
- x. One (1) pressure gauge each at suction & discharge of each pump set
- xi. One (1) Non return valve each at discharge of each pump set
- xii. One (1) lot of thermal insulation of coil section, fan section and drain pan and drain of PAC to avoid condensation as per cl. No. 3.5.1 of section -2.
- xiii. One (1) lot of insulation for refrigerant piping (suction line) as per cl. No. 3.5.1 of section-2.
- xiv. One no. Pan Humidifier system comprising of electrical heaters, water tank of adequate capacity, water supply connection, float valve, drain valve, overflow connection, humidistat, safety thermostat for control and interlocks.
- xv. One (1) set of heaters in plenum chamber complete with controls.
- xvi. One (1) lot of GSS duct of lock forming grade, zinc coated conforming to IS 277 coating grade 200.
- xvii. One (1) lot of supply air diffusers with volume control dampers and necessary splitters.
- xviii. One (1) lot of return air diffusers without volume control dampers.
- xix. One (1) lot of suitable fixtures for grills/ diffusers and support for ducting
- xx. One (1) lot of Thermal insulation of supply air & return air ducting with 25 mm thick resin bonded fiber glass wool of density 32 Kg/ m³



- xxi. One (1) lot of Acoustic insulation of SA duct with 12 mm thick resin bonded fiber glass wool of density 48 Kg/ m³ covered with 30G perforated aluminium sheet cladding upto a distance of 6 meters from outlet of PAC unit.
- xxii. One (1) no. fresh air unit as per cl. No. 2.1.2 o) of this section.
- xxiii. One (1) lot of pre & fine filters as per cl. No. 3.6 of sec-2.
- xxiv. One (1) lot of solenoid operated fire dampers.
- xxv. One (1) lot of 25 NB piping “B” class for the following:
 - a. Disposal of PAC’s condensate to nearest drain point.
 - b. Water inlet to Pan Humidifier and connection of pan humidifier overflow to the nearest drain point.
- xxvi. 15 nos. 2 TR Split AC as per Cl. No. 2.1.1.8 of this section.
- xxvii. One (1) lot of ventilation fans for non AC areas as per Cl. No. 2.2.0 of this section.
- xxviii. One (1) no. 415 V Motor Control centre common for AC & Ventilation system.
- xxix. One (1) no. Alarm/ Annunciation panel.
- xxx. One (1) lot of Local push button stations.
- xxxi. One (1) lot of cable accessories like lugs, glands, markers etc for power and control cables.
- xxxii. One (1) lot of Mandatory Spares as per Cl. No. 2.4.0.
- xxxiii. One (1) lot of MS brackets, M.S. frame & PVC drain piping fixing hardware like anchor bolts, nuts, fittings. Base plates and foundation bolts including anchor bolts, nuts, loose fittings etc. for equipment and as would be necessary for installation of the all the above equipments.
- xxxiv. One (1) lot of paints including final touch-up paint at site.

3.1.2 Besides, the Bidder shall take a note of the following while preparing his offer:

- a) Supply of power & control cables have been excluded from contractor’s scope of supply. Bidders shall submit the requirement of power & control cables (cable size, type & quantity) for HVAC system alongwith their respective bids. BHEL will provide power & control cables to the vendor as free issue item. Contractor shall have to choose their cables from the available sizes as listed in Annexure – I to section-1 and necessary modifications in their equipment for termination of these cables shall be made by contractor.
- b) Purchaser will lay two incomer cables upto contractor’s MCC in AHU room. Termination of the same shall be done by the contractor. Cabling (laying & termination) further to other equipments, panels etc and for control & interlocking of various equipments shall be in contractor’s scope. Supply of cable accessories such as lugs, glands, cable tags & markers etc. shall be included by the bidders in their offers along with supply of cable for Air-Conditioning & Ventilation system.
- c) Necessary cable trays will be supplied on free issue basis to the contractor, however necessary hardware for fixing the same on walls or elsewhere shall be included by the bidders in their offers.



- d) Earthing material viz. (GS flat 75 x 10, 50 x 6 & 25 x 3 mm) will also be supplied on free issue basis to contractor; however requirement shall be given by the bidders in their respective bids.
- e) Return air wooden boxing shall be provided in Shift Incharge room (FF) just above the AHU room to accommodate supply air duct and also the return air between control room and AHU room.
- f) In case the type test reports are found un-satisfactory, tests shall be carried out afresh by contractor without any additional cost implication to BHEL. However, inspite of a valid type test report if any of the tests are required to be repeated, same shall be payable to contractor on the basis of unit rates quoted by him. Bidder shall therefore furnish the charges for type test in his bid.
- g) Bidder shall provide makes for all items for this system as per the makelist provided in Annexure – B to section-5 of this specification. All such makes shall be subjected to acceptance of RRVUNL during detailed engineering stage. No additional price implication shall be made to BHEL on account of non-acceptance of proposed makes by RRVUNL.
- h) Bidder shall submit quality plan of the items of this system during detailed engineering stage in standard BHEL quality plan format for customer approval.
- i) Obtaining, "As Built" certification from purchaser or owner on applicable drawings. Completing documentation as per specification requirement shall be in contractor scope of services.

3.1.3 SCOPE OF SERVICES

3.1.3.1 Erection, Testing & Commissioning (ETC) requirements

- i. The scope of ETC shall include receipt of material at site, safe storage of material, handling of equipment/material at site, erection of equipment /material at site including fabrication, equipment and system testing, commissioning of the entire system. All material, consumables plus tools & tackles required for completion of ETC work shall be arranged by the Bidder.
- ii. Conducting performance guarantee tests to the satisfaction of Owner / Purchaser and handing over of the system to Owner / Purchaser. Bidder shall submit the PG test procedure at the time of detailed engineering for approval by owner/ purchaser.
- iii. It is the responsibility of the Bidder to maintain the system till it is handed over to Owner / Purchaser.
- iv. Cables laying for incomers to the HVAC MCC panel shall be done by the purchaser while termination of the same to the MCC panel end supplied under this contract is in bidder's scope of works. The contractor has to lay and terminate all the other power and control cables supplied under the present scope.
- v. Earthing of all installation under the present scope shall be done by the contractor.
- vi. All machinery -tools & tackles and consumables required for erection / commissioning of the system shall be arranged by the bidder.
- vii. Bidder shall ensure that sufficient quantities of commissioning spares are made available for timely completion of commissioning of the system. The bidder shall furnish a list of



Commissioning spares that will be brought by him. The unused commissioning spares shall be returnable to the Bidder.

- viii. Piping from water tap-off to inlet of pan humidifier. Water tap-off shall be provided by the purchaser at one point inside the AC plant room.
- ix. Piping from overflow of pan humidifier & packaged unit (disposal of condensate) to the nearest drain point.
- x. Cable laying & termination between Fire Alarm Panel (FAP) & MCC for HVAC system in order to switch off the system in case of fire.
- xi. Laying & fixing of cable trays on walls or elsewhere. Necessary hardware for the same shall be included by the bidder in their offer.
- xii. Painting of all the equipments shall be as per customer specification.
- xiii. After completion of erection and commissioning of the system, the bidder shall train site engineers of Purchaser/Owner so that they are fully conversant with both electrical and mechanical part of this package.

3.1.3.2 Civil Works

Major civil works such as room & foundations for various HVAC equipments shall be in purchaser's scope. However following shall be in contractor scope of services:

- a. Wall openings at suitable locations for duct, refrigerant/drain piping, Fresh Air unit & ventilation fans shall be made by the contractor. Associated civil works such as grouting, filling up crevices/cut outs etc during installations of equipments shall also be in contractor's scope. Any other damage caused to civil works during ETC work of the equipment/system shall be made good to the original finish by the contractor at no extra cost to the purchaser.
- b. Furnishing of details for construction of outdoor unit's mounting arrangement.
- c. Providing necessary guidance to / coordination with civil contractor so that appropriate sized / correctly located cut outs are made (by civil contractor) in false ceiling for installation of grilles / diffusers / return air.
However in case wall openings / cut outs have not been provided for either duct laying, louver fixing, ventilation fan(s) or fresh air fan, the same shall have to be made by the Contractor.
- d. Minor modifications, alterations in system installation as per customer's specific requirements shall be done without any extra cost to purchaser.

3.2 Exclusions

- i. Supply of Cable trays for laying cables. Installation wherever required is in contractor scope.
- ii. Supply of power and control cables. The bidder shall chose from the BHEL procured cables listed in Annexure-I to this section & furnish **quantity** and **type** of cables required complete system in their respective bids. Laying & termination is in contractor scope.
- iii. Various rooms and foundations for locating air conditioning equipments.
- iv. Supply & installation of false ceiling and openings in false ceiling for diffusers as required.
- v. Underdeck insulation of the air conditioned areas.



vi. Supply of GI flat for earthing of equipments.

3.3 Utilities Available

Construction water and 415 V power shall be available at one point each at the site. The contractor shall be required to make own arrangement for taking supplies from there.

3.4 Engineering Drawing/ Documents

Engineering shall start immediately after the award of the contract.

- i. Submission of all drg. / data sheet – Within 6 weeks from the PO date.
- ii. Approval of all drg. / data sheet – Within 10 weeks from PO date.

3.5 OPERATION & MAINTENANCE (O&M) MANUAL

Operation and Maintenance manuals shall be specifically compiled for the project by the bidders. The draft O & M manual shall be submitted along with supply of the various items. The O&M manual shall contain the following information:

- a. Description of the system and equipment with design particulars.
- b. Instruction for erection.
- c. Instruction for operation, maintenance and repair.
- d. Recommended inspection practices and inspection schedule.
- e. Ordering information for all replaceable parts.
- f. Recommendation for type of lubricants and frequency of lubrication.

3.6 Handing & Taking Over

It is the responsibility of the contractor to maintain the plant till it is handed over. The system/equipment before being handed over shall be subjected to successful run test for a minimum period of one week during which all readings shall be taken and recorded. Any defect noted during the period shall be rectified by the contractor. This running test shall be in addition to the performance tests specified earlier.

3.7 Various Heads to be quoted for

Based on the above input it is recommended that the bidders shall submit their LUMPSUM offers in the prescribed format only as given below:

TABLE-I

| Sl. No. | Item Description | Unit | Qty | Unit Rate | Total Amount |
|---------|---|------|-----|-----------|--------------|
| 1.0 | Supply of main items pertaining to following: | | | | |
| A. | Air Conditioning System | Lot | 1 | | |
| B. | Ventilation System | Lot | 1 | | |
| C. | Mandatory Spares | Lot | 1 | | |
| 2.0 | ETC of main items pertaining to the following: | | | | |
| A. | Air Conditioning System | Lot | 1 | | |
| B. | Ventilation System | Lot | 1 | | |



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3.8 Inspection & Testing

All the equipments shall be inspected prior to dispatch in line with relevant IS, approved GTP/ drawing, technical specification & BHEL/ customer approved QAP.

- 3.9** The contractor shall submit various drawings & documents for owner's/Purchaser's approval after award of contract as per enclosed Annexure-C to section 5. Drawing/ document no shall be chosen from this master document list. Title block attached as Annexure-I to section 3 shall be used for various drawing data sheets during detailed engineering stage.



ANNEXURE - I

LIST OF THE CABLES PROCURED BY BHEL

| |
|---|
| 2C x 2.5 sq mm PVC/Copper, Armoured Control Cable |
| 5C x 4 sq mm PVC/Copper, Armoured Control Cable |
| 5C x 2.5 sq mm PVC/Copper, Armoured Control Cable |
| 7C x 2.5 sq mm PVC/Copper, Armoured Control Cable |
| 10C x 2.5sqmm PVC/Copper, Armoured Control Cable |
| 14C x 2.5 sq mm PVC/Copper, Armoured Control Cable |
| 19C x 2.5 sq mm PVC/Copper, Armoured Control Cable |
| 2C x 10 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable |
| 4C x 16 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable |
| 3.5C x 35 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable |
| 3.5C x 95 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable |
| 3.5C x 400 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable |
| 1C x 50 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable |
| 1C x 630 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable |

- ✓ Bidder shall furnish size & quantity of Cables required in his bid on the basis of cable trench layout for control building enclosed.



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SECTION - 2

EQUIPMENT SPECIFICATION

1.0 CODES AND STANDARDS

The design, manufacture, inspection and testing of Air-Cooled Packaged Units shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment is 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 contractor of this responsibility.

The equipment shall conform to the latest edition to the following standards:

- IS: 659 - Safety Code for Air-Conditioning
- IS: 8148 - Specifications for Package Air Conditioners
- IS: 655 - Specification of metal Air-Ducts
- IS: 4999 (Part-51) - Noise Level
- IS: 3588 - Specifications of Electrical Axial Flow Fans
- IS: 2312 - Propeller type AC-Ventilation fans
- BS: 6540 Part I - Air Filters used in Air-Conditioning & General Ventilation
- IS: 4671 - Expanded polystyrene for Thermal Insulation purpose
- IS: 8183 - Bonded Mineral wool
- ASHRAE-16 -Method of testing of Room AC (coil capacity and air flow)
- ASHRAE- 58 -Methods of testing for Room AC (Heating Capacity)
- IS: 4894 -Centrifugal Fans
- IS: 325 -Induction Motors, three phase

2.0 GENERAL DESIGN AND CONSTRUCTIONAL REQUIREMENT

It is not the intent to specify herein all the details of design and manufacture. However, the equipment and the system 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/ Owner, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgment is not in full accordance with technical specification.

Besides, the following shall be noted:

- a. All the equipment shall be capable of withstanding the stresses, which may be experienced during normal operation and test.
- b. 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.



- c. All parts subject to substantial temperature changes shall be designed and supported such as to permit free expansion or contraction without resulting in leakage, harmful distortion misalignment or play.
- d. Proposal 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/Owner 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/ owner for his records.
- e. 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.
- f. Coupling guards and belt guards shall be furnished as applicable.

3.0 EQUIPMENT SPECIFICATION

3.1 PACKAGED AIR CONDITIONING UNIT

- a. Scroll compressor suitable for refrigerant R-407 with drive motor, water cooled condenser with integrally finned copper tubes, interconnecting refrigerant piping, insulation, vibration isolator, controls and accessories.
- b. The condenser shall be of horizontal, shell and tube type construction with water flowing inside the tubes and the refrigerant gas condensing outside tubes. The material for Shell and Tube shall be of Carbon steel and integrally finned Copper tubes
- c. Air handling fans, cooling coils, filter, etc.
- d. Cleaning efficiency of the filter shall be 90% down to 5 microns size, cooling coil manufactured from solid drawn Copper tube with mechanically bounded Aluminium fins.
- e. MS housing for the above items shall be finished with painting of suitable grade and shade. The housing shall be lined with thermal insulation on the inside.
- f. Vibration isolation pads.
- g. First charge of refrigerant and oil.
- h. One (1) Fresh air unit (FAU) consisting of fan, fan motor, pre and fine filters, ducting, damper, wall cowl & bird screens with necessary fixing frame.
- i. Three (3) nos. condenser cooling water pump (2 working + 1 standby) and one lot piping as per IS 1239, Part-I (heavy class), fittings valves, strainers, flow switches, pressure indicators, thermometers and accessories.
- j. Three (3) nos. induced draft FRP cooling tower with accessories (2 working + 1 standby)
- k. Lot air distribution system consisting of galvanized steel sheet ducting, supply air diffusers, return air grilles, dampers, complete with supports and aluminium frame work for mounting diffusers / grilles.



- i. Electrical strip heaters as required for humidity control and temperature control during winter season.
- m. Humidification package
- n. Thermal insulation and acoustic lining for supply air ducting drain line from drain point of packaged units to floor drain and refrigerant piping.
- o. Complete control system including sensor, relays controllers, control wiring, fine state shall be provided in the return air space (near the wall separating PAC room) to trip the fans in the event of a fire. Motorized fire dampers to be provided in the supply air duct and in return air wall / slab opening in order to isolate the respective packaged conditioner (PAC) plant room from the A/C area.

3.2 COOLING TOWER

- a. Induced draft type Single cell FRP cooling tower shall be provided for the cooling of condenser water.
- b. Cooling tower shall be designed, manufactured and performance tested as per CTI codes.
- c. The capacity of the cooling tower shall be adequate to take care of the cooling water requirement for the air conditioning system.
- d. The cooling tower shall be mounted on the roof above the plant room.
- e. Inside fills shall be of PVC.
- f. Cooling tower basin shall have accessories and connections for makeup, quick fill, drain screens and over flow. Float valve and limit switch interlocked with solenoid valves shall be provided in the makeup water
- g. The water distribution system shall be either open basin with gravity feed nozzles or pipe system with nozzles requiring not more than 0.42 kg/sq.cm. water pressure at rated capacity. The nozzles shall be spaced to give even distribution of water. The system shall be self-draining, non-clogging and designed for flexible operation and ready accessibility. Suitable measuring orifices shall be provided. All main piping connections shall be brought out and shall end in flanges to facilitate connections.
- h. All the fasteners shall be of stainless steel. Rubber/Neoprene gaskets must be used on all bolted joints as a seal against water leakage.
- i. Nozzles for cooling tower will be of brass/gunmetal/stainless steel.

3.3 CENTRIFUGAL PUMP AND MOTOR ASSEMBLY

- a. Centrifugal pump sets shall be used, recirculation of condenser water. The system shall be provided with 2 working + 1 stand by pumps each of 50% capacity.
- b. Piping shall be GI (galvanized -iron) medium class for less than 80 NB and MS (Mild Steel) heavy class for 80 NB and above.



- c. Flexible coupling should be used to connect pump shaft with motor. Pump & motor assembly shall be mounted on common base frame. Pump shall be provided with flanged inlet and outlet connection along with companion flanges.
- d. Pump head, capacity, characteristic shall be gradually rising from operating to shut-off point without any zone of instability. The pump BKW flow characteristic shall preferably be non-overloading type beyond rated capacity point. Pumps shall be rated for continuous operation.
- e. The capacity and head of the pump shall be designed by Bidder to ensure the required performance.
- f. Operating speed of the pumps shall preferably be less than 1500 rpm.
- g. Materials of the pump shall preferably be as follows: -
- | | |
|------------------------|---------------------------------|
| 1. Casing | Cast iron |
| 2. Impeller | Bronze |
| 3. Impeller ring | White metal |
| 4. Shaft | Forged Carbon steel |
| 5. Shaft sleeve | MS/ Bronze |
| 6. Bearing | Heavy duty ball/roller bearing. |
| 7. Stuffing box bushes | White metal |
| 8. Base plate | Fabricated MS |
| 9. Gland | Cast iron |
| 10. Coupling | Flexible |
| 11. Packing | Graphite asbestos |
| 12. Drive | TEFC induction motor |
- h. Pump shall be provided with suitable bearings sized adequately to take the maximum unbalance.
- i. Each pump shall be complete with pressure gauge at the suction and discharge complete with isolating valve. All integral piping required shall be supplied with the pump.
- j. Casing of chilled water pump shall be thermally insulated.
- k. The pumps shall be designed, manufactured and performance tested as per IS: 1520.
- l. The impeller and shaft assembly shall be statically and dynamically balanced.
- m. Dial type pressure and temperature gauges shall be provided for suction and discharge sides.

3.4 ELECTRIC DUCT HEATERS

- 3.4.1 Electric air heaters batteries shall be finned tubular element sheathed type construction of either ductable or slip-on installation type, the electric heater shall be UL approved design.

All heater capacity shall be sized for winter heating load also and where heater are used as reheater for humidity control, facility shall also be provided to control room dry bulb temperature during winter.

3.5 PAN HUMIDIFIER

- 3.5.1 Humidifying unit shall be pan type as per manufacturer's standard. The unit shall be complete with humidistat for ON-OFF operation of the section.



Whenever the 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. The humidifier tank shall be fitted with low level switch for putting off the electric heaters in case of low level of water. Visual alarm shall also be provided for low level of water. The tank will be provided with a drain connection, overflow connection. 3-Phase supply for the immersion heaters should be energized from the signal generated from the space humidistat.

3.6 AIR DISTRIBUTION SYSTEM

3.6.1 Ductwork

The ductwork inside the building shall be manufactured from hot-dip galvanized sheet complying with IS-277 with coating grade of 200 g/m². Fabrication shall conform IS: 655.

All ductwork support ties to the structure shall be made resilient with the use of 12mm thick mm-thick non-intercellular neoprene strip, gaskets or washers. All ductwork connections to air handling equipment shall be made via 15 cm long connections of rubber impregnated canvas material.

Bends and offsets shall have a minimum throat radius equal to the width of the duct where shorter radius bends than the width of the duct are taken internal splitters or turning vanes shall be used.

ADEQUATELY SIZED AIRTIGHT ACCESS DOORS WITH QUICK RELEASE FASTENERS SHALL BE PROVIDED WHERE NECESSARY.

3.6.2 Hangers and Supports

All ductwork shall be provided with adequate hangers to ensure rigid support and to prevent vibration.

Hangers shall be attached to the ceiling by anchor / expansion bolts or welded to the plate inserts. Hangers shall be trapeze type with self constructed from ISA 35x35 x 5 and hung from two steel rods of adequate size.

The fixing and supports interval shall not exceed 3 meters. The supporting and fixing arrangement shall be approved by the Purchaser.

3.6.3 Supply and Exhaust Air Grilles

In conventional attractive design, lamellas adjustable, aerofoil shape, broad front frame to allow airtight mounting. Frame and lamella made from steel with agreed stove enamel finish, conserved in nature color. Covered screw mounting with use of mounting frame.

Air-flow control by means of counter-moving, coupled lamellas, with sets of adjustable air deflection blades and an opposed blade damper located at the rear, adjustable from the front side, made of phosphatized sheet metal and varnished black.



3.6.4 Supply and Exhaust Air Diffusers

Square construction for mounting in false ceilings. Air vanes in lamella form for air distribution to all sides. Made from powder coated extruded aluminum with agreed finish, Connection boxes in air-foiled construction made of galvanized sheet metal with built-in throttling device and connecting piece. Ceiling diffusers shall be of the adjustable eyelash deflection blade type and shall have an opposed blade damper located at the rear. The diffuser shall be fixed to the ductwork by a purpose-made sub-frame assembly.

3.6.5 Gravity Dampers

Gravity dampers (Self acting dampers) are provided to ensure pressurization of electrical rooms, switchgear rooms, substations etc. Dampers shall be of gravity type designed such as not to allow infiltration of air from outside. The louvers of the dampers shall be freely mounted on spindles to allow the damper to open freely with the pressure developed in the premises. The damper shall be provided with flange at inlet the pressure inside the premises shall be 2-3 mm WC.

3.6.6 Valves, Thermometers and Pressure Gauge

Adequate number of valves of appropriate types shall be provided in the piping network.

Dial type (100 mm) mercury in steel thermometers shall be provided for measuring the water temperature, temperature of air at inlet & outlet.

3.6.7 Fire Dampers

To shut off fire section in air-conditioning plants, motorized fire dampers with suitable fire rating shall be provided. There shall be (potential-free contacts) for fire alarm to a central supervision tableau.

3.7 INSULATION

3.7.1 Thermal Insulation

The entire supply air and return air ducting for air conditioning system shall be insulated with 25 mm (density - 32-Kg/ m³) resin bonded fiber glass wool thermal insulation backed with aluminium foil conforming to IS: 8183.

The Portion of supply air ducting passing through outdoor / non air conditioned space shall also be insulated with 100 mm/ 50 mm thick resin bonded fiberglass thermal insulation respectively.

Insulation shall be fixed as per manufacturer's recommendation. Refrigerant piping shall be thermally insulated with 75mm thick expanded polystyrene conforming to IS: 4671.

AHU casing, drain-pipe and condensate pan shall be insulated with 25mm thick expanded polystyrene/ mineral wool.

3.7.2 Acoustic Insulation

The duct shall be acoustically lined from inside with 12 mm thick & 48 Kg/m³ density fiberglass wool and 30 gauge perforated aluminium sheets, upto 6 meters in length from outlet of each AHU. Aluminium sheet should have 5 mm dia, perforation at 8 to 10 mm centre distance.



3.8 FILTERS

3.8.1 Pre Filters

Panel type dry fabric filter having an efficiency of 90% down to 10-micron size particles shall be provided.

The filters shall be of clean-able 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 filter shall have aluminum 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 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 2.5 m/sec.

3.8.2 High Efficiency Filters (Micro-vee fine filters)

High efficiency filter having an efficiency of 99.9% down to 5 microns shall be provided in the fresh air unit and for other supply air fans of ventilation system.

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 an uniformly corrugated form to increase the surface area. The filter shall have Aluminum 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 frame duly tightened with four nut/ bolts. 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 2.5 m/sec.

3.9 VALVES

3.9.1 Refrigerant Valves

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

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 of the system.

3.9.2 Other Valves

All valves shall be suitable for service condition i.e. flow, temperature & pressure under which they are required.



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All gate, globe and check valves for sizes below 65 mm shall be of gunmetal or bronze conforming to IS 778 class 2. All valves of 65 mm and above shall be cast iron as per IS 780, class I/II, with stainless steel/ bronze internals.

3.10 AXIAL FLOW TYPE EXHAUST FANS FOR VENTILATION

▪ Constructional Features

3.10.1 Impellers

Single piece cast aluminium impeller shall be with blades of airfoil design. It shall be finished all over and balanced dynamically as per AMCA standard. Impeller shall be mounted directly on the motor shaft.

3.10.2 Casing (for axial flow fans)

Casing shall be as per manufacturer standard. Suitable arrangement for mounting of motor shall be provided.

3.10.3 Rain Protection Cowl

Rain protection cowls will be designed to suit wall exhaust/supply fans for protecting fans/motors from rain. It will be provided with bird screen.

3.10.4 Drive Motor

Motor shall be of totally enclosed type complying with the electrical motor specification.

3.10.5 Speed

The speed of the fan shall not exceed 1000 rpm for fan with impeller diameter above 450 mm and 1500 rpm for with impeller diameter 450 mm and less. However for fresh air fan above restriction on speed shall not be applicable since the static pressure requirement is high at lower discharge capacity. The first critical speed of rotating assembly shall be at least 25% above operating speed.

3.10.6 Flame Proof Construction

The fans used for battery rooms shall be of flame proof constructions with inlet and outlet dampers. The duct and all other parts of this system coming in contact with acid fumes shall be epoxy painted.

3.11 MOTORS

Motors shall be provided as per RRVUNL approved documents.

3.12 PANELS

3.12.1 MOTOR CONTROL CENTER

- ✓ **Please refer Annexure - II to section 1 – Vol-IV (Section D.9) take care of customer requirements for Panels/ Switchgears.**



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3.12.2 ALARM/ ANNUNCIATION PANEL

The panel shall be floor-mounted type and shall be kept in control room.

- ✓ **Please refer Annexure - II to section 1 – Vol-IV (Section D.9) take care of customer requirements for Panels/ Switchgears.**

3.12.3 LOCAL PUSH BUTTON (LPB) STATIONS

- ✓ **Please refer Annexure - II to section 1 – Vol-IV (Section D.15) take care of customer requirements for Panels/LPBS.**

4.0 Noise & Vibration

Noise control measures shall be adopted to restrict noise levels in and around the plant. Maximum noise levels tolerable in rooms & offices, work areas and at the plant boundary have been specified herein. The equipment and the services shall be designed such that these levels are not exceeded.

The Bidder shall indicate the maximum noise level guaranteed for each equipment / system with detailed description of noise control measures adopted.

The maximum noise levels for rooms and offices must permit a good understanding of speech. Limiting exposure values of sound pressure levels for different areas are given below.

Office conference rooms : 65 dB (A)

Control rooms, Computer rooms : 55 dB (A)

The plant and machinery shall be designed such that the continuous exposure of noise level of 85 dB (A) is not exceeded. If impulse noise is present, the maximum allowable impulse noise level is 140 dB (A).

4.1.1 Control of Noise

Noise control shall be achieved by way of sound isolation, sound absorption, Vibration isolation etc. For this purpose, the Bidder shall adopt good engineering practices such as well balanced (statically and dynamically) low speed machinery, acoustically correct enclosures, structures and supports free from resonance, acoustically designed fluid path for ducting and pipe work etc. Vibration standards shall confirm to VDI 2056 – ‘Good Zone’.

5.0 Inspection

The inspection of the equipment shall be carried out at manufacturer’s works as decided by the Purchaser / Consultant.

The makes of all the equipment / items shall be furnished for approval to the Purchaser / Consultant.

6.0 Guarantee

Satisfactory operation of the equipment offered shall be guaranteed for 12 months from the date of commissioning or 18 months from the date of receipt of all items in satisfactory condition, whichever is higher. Contractor shall undertake to repair or replace any part which is defective due to faulty materials, design or workmanship.



7.0 QUALITY

7.1 Quality Plan

The Quality plan format for quality plan is given at section 5. Contractor shall submit duly filled in quality plans for approval of purchaser / owner.

7.2 Field Quality Plan

The bidder shall submit the field quality plan for approval of Purchaser / owner. Various checks required beginning receipt & storing of material to commissioning of system should be mentioned in field quality plan.

8.0 Performance Guarantee Test

After complete installation at site, the Air conditioning and Ventilation systems shall be subjected to tests to show achievement of guaranteed parameters in line with the requirements of specification/ standards/ codes and to the satisfaction of Purchaser/ Owner. **The contractor shall submit a detailed PG Test procedure for purchaser/ customer approval.**

✓ Pre-Requisites to the PG Tests

- a. The responsibility for conducting the tests and arrangement of necessary instruments rests with the contractor.
- b. The contractor shall furnish a written statement to the effect that work covered in the contract has been completed for the system for which PG tests will be carried out.
- c. All the erection/ commissioning protocols in respect of alarm/annunciation/control system, vibration and noise level data of packaged unit commissioning shall be made available during PG test.
- d. All approved data sheets for the plant/system for which PG test is to be carried out, shall be made available during PG test.
- e. Uninterrupted Power supply within specified parameters for the duration of the tests.
- f. All instruments required for the PG test shall be provided by the contractor.
- g. Calibration of the testing equipments from a govt. approved laboratory shall be the responsibility of the contractor.
- h. Contractor shall ensure that all instruments installed in air-conditioning system as well as all instruments required for conducting acceptance tests shall be only calibrated instruments.
- i. Cleanliness of Plant/ System
- j. The plant/ system shall be jointly inspected by OWNER and contractor. A joint protocol shall be signed that the plant is fit for PG test.
- k. Joint protocol of overall record/ test shall be signed at the time of PG test.

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AC AND VENTILATION SYSTEM

| | | |
|----------------------------------|---|-----------------------------|
| SPEC. NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME: III SECTION: D12 |
| PART – B | RRVUNL, 2x660 MW, Super-Critical TPS, Stage-V Unit # 7 & 8 at Suratgarh, Rajasthan AIR-CONDITIONING & VENTILATION | SHEET 1 OF 28 |

1.0 SCOPE

~~This specification covers design, supply and installation, commissioning and testing of Air-conditioning and Ventilation system for 2X660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan.~~

AIR-CONDITIONING SYSTEM

1.1 ~~The following are the areas to be Air-conditioned~~

- ~~(i) Main control room comprising unit control room, electronic cubicle rooms, shift in-charge engineers room, maintenance engineers room, printer room, UPS room, conference room, and analyser room in T.G. building.~~
- ~~(ii) The entire service and administration buildings.~~
- ~~(iii) ESP Control room, DM Plant Control room, Coal handling system control room, Ash handling system control room, Switchyard control room, Switchyard relay room, PLC rooms of other areas.~~
- ~~(iv) Chemical lab (in DM plant building), Chemical House (in pre treatment plant), Conference Rooms.~~

1.2 ~~The following are the various Input data considered in the Design of Air-conditioning system:~~

1.2.1 ~~Outside design conditions :~~

| | DRY BULB TEMPERATURE * | WET BULB TEMPERATURE * |
|--------------------|-----------------------------------|-----------------------------------|
| SUMMER | 45 °C | 23.9 °C |
| MONSOON | 37.2 °C | 26.7 °C |
| WINTER | 7.2 °C | 5 °C |

~~* Bidder to consider the latest prevailing outside design condition for preparation of heat load estimation.~~

1.2.2 ~~Inside design conditions to be maintained in Air-conditioned area:~~

- ~~a) Dry bulb temperature : 22 °C ± 1 °C~~
- ~~b) Relative Humidity : Not exceeding 60% for office areas and 50% for all control rooms.~~

1.2.3 ~~For Air conditioned areas, fresh air would be provided at the rate of one (1) air change per hour or 35 cu.m per hour per person inline with ASHRAE-62,~~

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whichever is higher.

~~1.2.4 Make-up water for AC and Ventilation system equipments (cooling tower, expansion tank and air washer/UAF make up water tank) shall be supplied through dedicated softening plant (ion exchange type). The softening plant is in bidder scope.~~

2.0 REFERENCE CODES AND STANDARDS

All materials and equipments provided shall comply with the following Standards:

| | |
|----------------|--|
| ASHRAE 15 | Safety code for mechanical refrigeration |
| ASHRAE 30 | Methods of testing Liquid chilling package |
| ARI 430 | Central station Air Handling Units |
| ARI 410 | Forced Circulation Air-Cooling and Air Heating coils |
| IS 277 | Galvanised Steel Sheets |
| IS 325 | Three phase induction motors |
| IS 655 | Metal Air ducts |
| IS 7613 | Method of testing panel type air filters for air-conditioning and Ventilation process. |
| ARI 550 | Water chilling package using the Vapour compression cycle |
| IS 4671 | Expanded polystyrene for thermal insulation purposes. |
| IS 3588 | Electric axial fans |
| IS 4894 | Centrifugal fans |
| UL 555 | Fire dampers |
| IS 7098 Part-1 | Power cables |
| IS 1554 Part-1 | Control cables |
| IS 4237 | MCC |
| IS 6875 | PB Stations |
| Control panel | Individual electrical components conform to respective IS |

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3.0 SYSTEM DESCRIPTION

3.1 ~~Air-Conditioning Systems~~

- a) ~~TG building Main control rooms and other air-conditioning areas shall be air conditioned by water cooled Chilled water packages with rotary screw compressors (Two Operating + One Standby) shall be considered to meet the above requirements. The various areas to be air conditioned are given in Appendix – I~~
- b) ~~The entire Service building and administration building shall be air conditioned by suitable number of rotary screw compressors or water cooled Package units with cooling towers and cooling water pumps. The final equipment configuration shall be decided by the bidder.~~
- c) ~~ESP Control room, DM Plant Control room, Chemical lab in DM plant building, Coal handling system control room, Ash handling system control room, Switchyard control room and Switchyard relay room shall be air-conditioned by means of adequate number of a separate DX plant (water cooled) or water cooled Packaged air-conditioners (with cooling towers and cooling water pumps) with suitable numbers of working and common standby unit.~~ The capacity and quantity required shall be finalized by the bidder.
- d) ~~Chemical House (PT plant) and Conference Rooms will have to be air-conditioned by Means of adequate number of water cooled Packaged air-conditioners (with cooling towers and cooling water pumps) suitable numbers of working and common standby unit. The capacity and quantity required shall be finalized by the bidder.~~
- (e) ~~For chemical lab, the air-conditioning system shall be designed for 100% outdoor air (the room air is exhausted and not recirculated through the A/C unit).~~
- (f) 10% margin in equipment capacity over peak heat load calculated considering solar load and all internal loads due to equipment, lighting, fresh air, occupants, etc shall be considered.

3.1.1 AC Plant : Central Chilled Water Plant catering A/C areas of TG building

~~The central chilled water plant shall cater to the air-conditioning of Main control room, electronic cubicle room, shift in-charge engineers room, maintenance engineers' room, printer room, UPS room, conference room and analyser rooms.~~

~~Chilled water at 7 °C from these units would be supplied to Air handling units located in the AHU room adjacent to different areas to be Air-conditioned. Chilled water from the air handling units after picking up heat load will be at 12 °C approx. which will be returned to the chiller units for cooling and re circulated to air handling units. If any AC area will be located at a far off location from the AHU room or if AHU room located at the roof of the AC area, then it will be air-conditioned with ducted supply from AHU location and the return air will taken through insulated return air duct back to the AHU room.~~

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~~The cool air is supplied to the A/C area from AHU through ducting and the warm air from the A/C area after heat pick is taken to the AHU room through space between false ceiling and roof. In the AHU room, the warm air is cooled by the chilled water at the cooling coil of AHU and the cooled air is supplied to the A/C area and the process repeats.~~

~~The cooling towers for the Air-conditioning plant would be located near the AC plant room, or on the roof of AHU room along with expansion tank and its necessary accessories.~~

~~The AC plant would essentially comprise of the following equipment :~~

- ~~i. Three (3) nos. (Two Operating and one standby) water Chilling units with R134a Refrigerant Rotary screw compressors, each of suitable capacity.~~
- ~~ii. Three (3) nos. (Two Operating and one standby) Chilled water pump sets of adequate capacity to match chilling unit chilled water flow rate.~~
- ~~iii. Three (3) nos. (Two Operating and one standby) condenser water pump sets of adequate capacity to match chilling unit condenser water flow rate.~~
- ~~iv. Three (3) nos. (Two Operating and one standby) Induced draft FRP Cooling towers of adequate capacity to match chilling unit.~~
- ~~v. Suitable nos. of air handling units (Numbers Operating and one standby), each of suitable capacity are located in the AHU room (location of AHU rooms to be decided by Bidder).~~
- ~~vi. Air distribution system comprising ducting, diffuser / grilles, thermal and acoustic insulation for ducting.~~
- ~~vii. Main control panel, local control panel and local push button station~~
- ~~viii. Insulated Expansion tank with all necessary accessories.~~
- ~~ix. Electrical strip heaters with controls. Humidification package with pan humidifiers (if required) for system.~~
- ~~x. Piping, valves and specialities for chilled water and condenser cooling water systems with thermal insulation for chilled water systems.~~
- ~~xii. Make up water for the air-conditioning system to be supplied to the cooling tower sumps and to expansion tank from clarified water through water softening plant (Ion exchange type) and strainers.~~
- ~~xiii. Fresh air system consisting of pre filters, fine filters, tube axial fan, ducting, volume control dampers etc., shall be provided in the AHU rooms. The efficiency of pre-filters shall be 90% down to 10 microns and that of fine filters shall be 99% down to 5 microns.~~
- ~~xiv. Necessary drain piping up to the nearest floor drains for each AHU with thermal insulation.~~
- ~~xv. Monorail with hoist will be provided in the A/C plant room for handling. (The chiller units shall be housed in a dedicated building)~~

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4.0 ~~EQUIPMENT TO BE SUPPLIED~~

4.1 ~~Screw Chilling unit – AC plant~~

~~The capacity of chilling unit will be based on the following :~~

- ~~i) Fouling factors - Cooler : 0.0001 hr.ft².°F / BTU / (0.018 M² Hr °C / Kcal)~~
- ~~ii) Chilled water In / Out temperature : 12 °C / 7 °C~~
- ~~iii) Chilled water flow rate : 0.7 M³/hr / TR~~

~~Each Screw chilling unit shall comprise of the following :~~

- ~~a) Microprocessor controlled water cooled water chiller package suitable for R134a having single/multiple semi hermetic screw type compressor, motor, unit mounted starter, crankcase heater, automatic capacity control etc.~~
- ~~b) One (1) no. shell and tube type water cooled condenser complete with hot gas inlet, liquid outlet, relief and purge connection for refrigerant, water inlet and water outlet connection, drain connection with valve suitable for above selected capacity.~~
- ~~c) One (1) no. Shell and tube type / flooded water chiller suitable for above selected capacity complete with liquid inlet, Vapour outlet connection for refrigerant, water inlet and water outlet connection, drain connection with valve and chiller insulation.~~
- ~~d) Thermostatic expansion valve, Refrigerant piping, valves and fittings interconnecting Chiller, compressor, condenser and expansion device and refrigerant piping including insulation etc~~
- ~~e) Refrigerant piping, valves and fittings interconnecting Chiller, compressor, condenser and expansion device.~~
- ~~f) First charge of refrigerant gas and oil, base frames, vibration isolation pad, integral wiring and unit mounted isolator / fuse switch.~~
- ~~g) Flexible connection (Corirubber with retainer rods and flanges suitable to operate at the design pressure) between chilling unit and piping.~~
- ~~h) Lot-Controls comprising the following:~~
 - ~~• HP/LP cut-outs~~
 - ~~• Oil pressure failure switch~~
 - ~~• Solenoid valve~~
 - ~~• Antifreeze thermostat~~
 - ~~• Cooling thermostat~~
 - ~~• Water flow switch at the outlet of condenser and chiller.~~
- ~~i) Vibration isolators for chillers, pumps, motors and cooling towers.~~

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4.2 Centrifugal water pump set

~~The centrifugal pump set shall be Horizontal split casing centrifugal pump set and each centrifugal water pump set shall comprise of the following :-~~

- ~~a) One (1) no. Horizontal split casing centrifugal pump.~~
- ~~b) One (1) no. adequately sized Induction motor suitable for 415 V, 3 phase, 50 Hz supply.~~
- ~~c) One (1) set of base plate, coupling guard, anti vibration pads and foundation bolts.~~
- ~~d) Chilled water pump set will include thermal insulation of pump.~~
- ~~e) Flexible connection (Corirubber with retainer rods and flanges suitable to operate at the design pressure) between pump and piping.~~
- ~~f) Drain piping from pump to nearest floor drain~~

4.3 Air Handling Unit (AHU)

~~The AHU shall be of double skin construction with Filter section, cooling coil section and fan section. Each AHU shall comprise of the following:~~

- ~~a) Fan section complete with forward curved/Backward curved Double Inlet Double Width (DIDW) centrifugal fan mounted on spring type vibration isolators. Fan outlet velocity not to exceed 11 m/s. AHU mounted on vibration pads.~~
- ~~b) One (1) no. adequately sized Induction motor suitable for 415 V, 3 phase, 50 Hz supply with drive package comprising of fan pulley and V-belt.~~
- ~~c) Cooling coil section with suitably sized chilled water cooling coil made of copper tubes and aluminium fins complete with purge valve at top and drain plug at bottom. Velocity across cooling coil not to exceed 2.5 m/s.~~
- ~~d) Filter section containing washable synthetic type air filters having GSS frame. Pre filters shall be provided in front of cooling coils and fine filters shall be provided in the common supply duct.~~
- ~~e) Drain piping from AHU to floor drain.~~
- ~~f) Flexible connection between fan and ducting.~~
- ~~g) One common set of electrical strip heater package of suitable capacity complete with contact, humidistat, safety thermostat, heater box with insulation etc for monsoon reheat mounted inside the A/c plenum / duct.~~
- ~~h) Controls comprising :

 - ~~• One (1) no. 3 way mixing valve with actuator for each AHU (wherever applicable).~~
 - ~~• One (1) no. proportioning thermostat for each AHU~~~~

4.4 Cooling Tower

- a) Design wet bulb temperature : 26.7 °C
- b) Approach : 4 °C
- c) Cooling tower water outlet temperature : 31 °C
- d) The condenser water flow rate : 1 M³/hr / TR

The cooling tower shall be Induced draft (single cell) FRP cooling tower and shall comprise of Fan, fan motor, drive package, FRP basin, FRP / HDGS louver, fills, drift

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eliminators, nozzles, make-up connection, over flow connection, drain connection, ladder and supporting structure.

4.5 **Packaged Air Conditioners**

Packaged Air conditioning (PAC) systems for air conditioning of areas as listed in Appendix - I shall be air conditioned by a number of water-cooled condenser type PAC units. Each water-cooled PAC unit comprises of scroll refrigerant compressor with motor, water cooled type condenser and cooling coil with air handling fan and associated controls and accessories.

Cooling water for the condensers of PAC units shall be supplied from cooling towers located on top of the building and after heat pick-up; this water is circulated back to cooling tower by the condenser cooling water pumps for cooling and recirculation. ~~Make up water connection from softening plant (Ion exchange) will be included.~~

Cooled and dehumidified air from the PAC units of the respective A/C area will be circulated by means of supply air ducting and diffusers from PAC units to A/C area. This air after heat pickup from the A/C area is sucked through return air grilles located in false ceiling into PAC units by means of air handling fan suction for cooling and recirculation. Fresh air is supplied through fresh air fan filter arrangement located in PAC plant room.

If any AC area will be located at a far off location or PAC room is located at the roof of the AC area, then it will be air-conditioned with ducted supply from AHU location and the return air will taken through insulated return air duct back to the AHU room.

4.6 **Piping and Valves**

a) Piping shall be

- ERW, Black, IS-1239 heavy class for pipe sizes up to 150 NB
 - ERW, IS 3589 fabricated from IS 2062 plates for pipe sizes 200 NB to 450 NB
- b) Isolating valves shall be butterfly valve type for valve size 50 NB and above.
c) Isolating valves shall be gate valve type for valve size below 50 NB.
d) Strainers shall be Y-type
e) Chilled water and Condenser water Piping shall be designed such that, for pipe sizes of 50 NB and under, maximum velocity is 1.2 m/s and friction rate is not exceeding 250 Pa/m. For pipe sizes above 50 NB, maximum velocity is 3 m/s and friction rate is not exceeding 400 Pa/m.
f) Isolating valves shall be provided at inlet and outlet piping of Chilling units, pumps, cooling towers and Air Handling Units.
g) Strainers shall be provided at the inlet piping to AHU and Pump.
h) Non return valves shall be provided at the outlet of Pumps.
i) Volume control dampers shall be provided in all branch ducts and in the main ducts from AHU/PAC to throttle the air volume.

4.6.1 **Air distribution system**

- Rectangular Duct: GSS supply air ducting and return air ducting with Zinc coating 200 Gms /sq.m or better.

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- The supply air ducting to be designed based on equal friction method to have an initial velocity not exceeding 9 m/s and friction rate 0.8 Pa/m.
- The return air ducting to be designed based on equal friction method to have an initial velocity not exceeding 7.5 m/s and friction rate 0.66 Pa/m.
- Duct aspect ratio for rectangular ducts. Not exceeding 1:4.
- Maximum neck velocity for supply air diffusers 2.0 m/s.
- Maximum neck velocity for return air diffusers 1.5 m/s.
- Maximum face velocity for supply air grills 2.0m/s.
- Maximum neck velocity for return air / exhaust grilles 1.5 m/s.
- Maximum airflow velocity across flat type pre filters (90% efficiency down to 10 microns) shall be 1.75 m/s.
- Maximum velocity across louvers 2.5 m/s.
- Motorized fire dampers to be provided in the supply air duct, return air ducts, all wall and floor crossings to isolate the area in the event of fire. The space around the ducts and pipes to be sealed with fire retardant material.

4.7 **Thermal and Acoustic insulation**

- a) ~~Thermal insulation of ducting : Entire supply air duct will be thermally insulated with 25 mm thick fibre glass of density 32 kg/cu.m~~
- b) ~~Acoustic insulation for first 6 m length from AHU outlet with 12mm thick resin bonded fibre glass wool of density 48 kg/cu.m covered with RP tissue and 30 G perforated Aluminium sheet.~~
- c) ~~Chilled water piping shall be thermally insulated with expanded polystyrene of density 20 kg/cu.m and finished with sand cement plaster. The thickness of piping insulation shall be as follows:~~
 - ~~Pipe diameter up to 25 NB : 40 mm thick insulation~~
 - ~~Pipe diameter above 25 NB and up to 125 NB : 50 mm thick insulation~~
 - ~~Pipe diameter 150 NB : 75 mm thick insulation~~
- d) ~~All exposed roof in AC areas/AHU/PAC rooms shall be insulated on under side by 50 mm thick insulation by bidder.~~

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4.8 **Pressure gauges ***

Direct reading, pipe mounted Dial type Pressure gauges with Six (6) inch phenolic dial (White dial with black numerals) will have to be provided at :

- a) One (1) each at Suction and discharge side of each pump set.
- b) One (1) each at chilled water inlet and outlet of each AHU.
- c) One (1) each at chilled water inlet and outlet of each chilling unit.
- d) One (1) each at condenser water inlet and outlet of each chilling unit.

4.9 **Temperature gauges* / Stem type thermometer***

Direct reading, field mounted Six (6) inch dial (White dial with black numerals) temperature gauge will have to be provided at :

- a) One (1) each at chilled water inlet and outlet of each chilling unit.
- b) One (1) each at condenser water inlet and outlet of each chilling unit.
- c) One (1) each at condenser water inlet and outlet of each cooling tower.
- d) Steam type thermometer at chilled water inlet and outlet of each AHU.
- e) Steam type thermometer at condenser water inlet and outlet of each PAC.

* - The quantity may vary depends on the requirement.

4.10 **Fresh air unit**

One (1) no. Fresh air unit each for separate AHU room supplies fresh air to the AHU room and is located in the AHU room. Each fresh air unit shall comprise of :

- a) One (1) no. Tube axial fan with motor
- b) Pre filter with HDPE media having 18 G GSS frame. The efficiency of the filters shall be 90% down to 10 microns. Maximum Velocity across pre filter 1.75 m/s.
- c) Fine filter with HDPE media having 18 G GSS frame. The efficiency of the filters shall be 99% down to 5 microns. Maximum Velocity across Fine filter 1.25 m/s.
- d) Fresh air Louver, Volume control damper and connecting duct.

4.11 **Louvers / Wall Cowl with bird screen**

Louver / Wall Cowl with bird screen shall be provided for supply air inlet and for exhaust with Tube Axial fans. The louvers shall consist of parallel metallic blades. For louvers, the minimum projected width of blades in horizontal plane shall be 150mm with the blades inclined at minimum 35 degrees. Design face velocity for louvers is 2.5 m/s.

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Bird screen of 10 sq.mm and minimum 16 G wire mesh is to be provided on the outer face of Louvers.

4.12 Expansion tank

MS expansion tank insulated complete with vent, make-up water connection, overflow and drain line.

4.13 Direct Expansion System (DX System)

~~Independent central air conditioning system of direct expansion (DX) type with Screw compressor has to be considered as an alternative if the resulting TR is very high and cannot be met by using package units for the following areas.~~

- ~~i. ESP control room~~
- ~~ii. DM plant control Room and Chemical Lab~~
- ~~iii. Coal handling system control room~~
- ~~iv. Ash handling system control room~~
- v. **Switchyard control room**

~~The water cooled condensing unit along with the condenser cooling water pumps and cooling towers shall be provided. The number of condenser cooling water pumps, cooling towers shall be equal to the number of condensing units. The number of condensing units shall be decided by the Contractor. In addition, one common standby condensing unit and the associated equipment shall be provided. The air conditioning system shall also include adequate number of air handling units, associated air distribution system, condenser water piping, valves and fittings, insulation, strip heaters, humidifier and all other accessories and controls. A central control panel within air conditioning plant room is to be provided. Local control panel for individual AHU rooms and other areas to be provided. Make up water from water softening plant (Ion exchange type) for the condenser cooling water system to be provided at the air conditioning cooling towers as per required pressure and flow. Fresh air system shall be provided in all the AHU rooms.~~

- ~~a. The air handling units shall be draw through type and casing shall be of double skin construction. Fans shall be double width double inlet (DWDI) centrifugal type. Fans shall have forward or backward curved blades. The cooling coil face air velocity shall not exceed 2.5 m/sec.~~
- ~~b. Strip heaters of suitable capacity with controls shall be provided in the supply air duct plenum.~~
- ~~c. Humidification package with all necessary controls.~~
- ~~d. Air distribution system including ducting, grills, diffusers fresh air unit, fire dampers, volume control dampers, thermal and acoustic insulation for ducts and accessories.~~
- ~~e. Monorail and hoist for handling the A/C units, pumps, etc.~~
- ~~f. Safety and protective devices as specified.~~

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~~g. The condensing plant and pumps shall be located in a separate room and the A/C plant room layout shall be made such that adequate space is provided for maintenance of condensing units, pumps etc.~~

5.0 CONTROL PHILOSOPHY FOR AC SYSTEM

~~5.1 Separate PLC based control system is envisaged for AC plant in TG building and AC plant in ESP building also the interface connection for monitoring all the PLC shall be provided to DCS.~~

~~5.2 One collective fault signal from each AC plant control system shall be hardwired to DDCMIS for annunciation in UCR.~~

~~5.3 All operations are to be performed by the operator, control system will take care of safety and protection interlocks.~~

~~5.4 Description of control system for each AC plant :~~

~~5.4.1 PLC based local control system shall be provided for the operation and control of following AC plant auxiliaries:~~

- ~~a) Chiller water pumps~~
- ~~b) Condenser water pumps~~
- ~~c) AHU~~
- ~~d) Fresh air fan~~
- ~~e) Temperature and humidity control inside A/C area.~~

~~5.4.2 The control system will consist of necessary operating and safety controls, pushbuttons, indicating lamps, annunciator for annunciating trip of each auxiliary in AC plant etc.~~

~~5.4.3 All auxiliaries mentioned above can be operated from the control panel, in addition each drive shall be provided with local push button station for start & stop, the stop push button shall be lockable.~~

~~5.4.4 Each Chiller unit shall have its own skid mounted microprocessor based control system. It consists of unit-mounted starter, crankcase heater, automatic capacity control etc. This integral control system shall have following minimum protective cut-outs :~~

- ~~a) HP/LP cut-outs~~
- ~~b) Oil pressure failure switch~~
- ~~c) Antifreeze thermostat~~
- ~~d) Water flow switch at the outlet of condenser and chiller.~~
- ~~e) Any other control recommended by the vendor.~~

~~5.5 Chiller control system will be complete with instruments and cabling to perform above functions.~~

~~5.6 Chiller control system shall have necessary signal exchange with AC plant control panel to build required safety interlocks.~~

~~5.7 Chiller unit can not be started unless chiller water pump, condenser water pump, and AHU are started.~~

~~5.8 Each AHU shall be provided by PLC based local control panel which shall be suitably interfaced with A/C Plant main control panel.~~

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- 5.9 ~~A/C Plant room main control panel shall accept fire alarm signal from fire detection system and shall trip all A/C plant on fire alarm and shall close fire dampers.~~
- 5.10 ~~Fire damper controls shall be implemented in AHU local control panel. Fire damper position shall be indicated on LCP with the help of limit switches.~~

6.0 **MATERIAL OF CONSTRUCTION**

6.1 **Chilling Unit:**

- ~~Shell - condenser~~ : ~~Carbon steel~~
- ~~Shell - cooler~~ : ~~Carbon steel~~
- ~~End Cover~~ : ~~Carbon steel~~
- ~~Tube sheets~~ : ~~Carbon steel~~
- ~~Tubes~~ : ~~Seamless copper~~

6.2 **Air Handling Unit:**

- AHU casing : 1.2 mm thick GSS
- Cooling coil : Copper tube and Aluminium fins
- Fan casing : Galvanized steel
- Fan shaft : EN 8

6.3 **Centrifugal Pump Set:**

- Casing : Cast iron, IS:210 Gr. FG 260
- Impeller : Bronze IS 318 Gr 2
- Shaft : EN 8
- Base plate : Fabricated MS

6.4 **Cooling Tower:**

- Casing : FRP
- Air inlet Louver : FRP / HDGS
- Fill : PVC
- Nozzles : Bronze/Polypropylene
- Cold water basin : FRP

6.5 **Air Distribution system:**

- Ducting : GSS Zinc coating 200gms /sq.m or better
- Diffuser : Aluminium powder coated
- Grille : Aluminium powder coated
- Volume control damper blade & frame : 18 G GSS
- Fire damper blades and frame : 16 G GSS
- Louver Frame : 16 G GSS
- Louver Blade : 20 G GSS

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6.6 **Piping and Valves:**

- Pipe sizes up to 150 NB : ERW, Black, IS-1239 heavy class
- Pipe sizes 200 NB to 450 NB : ERW, IS 3589 fabricated from IS 2062 plates
- Valves 50 NB and Below : Gun metal construction or Bronze
- Valves above 50 NB : Cast Iron, IS 210 Gr FG 260

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APPENDIX - I *

~~*- A/C LOAD BREAK-UP (To be furnished by the bidder)~~

| SL No | Name of the Area | Area(ft2) | TR | CFM |
|------------------|---|----------------------|----------------------------|----------------|
| 1 | Main control room comprising the below(TG building) to be air conditioned by Chilled water plant | | Based on Summer conditions | |
| 1.1 | Unit control room (common for both units) | | | |
| 1.2 | Electronic cubicle room | | | |
| 1.3 | Shift in charge engineers room | | | |
| 1.4 | Maintenance engineers room | | | |
| 1.5 | Printer room | | | |
| 1.6 | Conference room | | | |
| 1.7 | Analyser room | | | |
| | Total | | | |
| 2 | Air cooled Split A/Cs (As required, each 2 TR) | | | |
| 2.1 | Miscellaneous offices / work spaces | | | |
| 3 | A separate direct expansion plant OR package units will be provided for the following areas | | | |
| 3.1 | DM Plant Control room & Chemical lab | | | |
| 3.2 | Coal handling system control room | | | |
| 3.3 | Ash handling system control room | | | |
| 3.4 | Switchyard control room. | | | |
| 3.5 | All PLC rooms | | | |
| 4 | Screw chiller/Packaged air conditioner shall be provided for the following buildings / areas : | | | |
| 4.1 | Administration Building | | | |
| 4.2 | Service Building | | | |
| 4.3 | Chemical House (PT Plant) | | | |
| 4.4 | Conference Rooms | | | |
| 4.5 | ESP Control room | | | |
| | Note | | | |
| 1 | The bidder shall indicate the capacity of strip heaters and humidifier for winter heating. | | | |

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APPENDIX - II

BUILDING CONSTRUCTION DETAILS *

| SL.NO. | ITEM | CONSTRUCTION |
|--------|--|--|
| 1.0 | Roof (*) Cast in-situ Roof | 150 mm thick RCC +50 mm to 100 mm screed + water proofing |
| 2.0 | a) Floor (RCC) b) Floor in station building (steel beams with RC floor) | 150 mm thick RCC + 50 mm thick floor finish. 150 mm thick RCC + 50 mm thick floor finish. |
| 3.0 | Outside walls | 230 mm thick brick wall + 13 mm thick inside plaster + 20 mm thick outside plaster |
| 4.0 | Glass for window and partition (except unit control room) | Single sheet plain glass 6 mm thick |
| 5.0 | Glass for unit control room (partitions) | Double plate glass 6 mm thick towards facing T.G hall for unit control room area and single sheet plain glass 6 mm thick for other partitions. |

(*) Considered in the calculation of A/C load/ bidder to confirm.

Roof of all AC areas and AHU rooms / PAC Plant rooms will be insulated on the underside by 50 mm thick standard thermal insulation. The under deck insulation of exposed roof slab is to be carried out by civil contractor.

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VENTILATION SYSTEM

1.0 AREAS TO BE VENTILATED

1.1.1 TG Building and TG MCC room

~~Evaporative cooling ventilation system for the Turbine building. The inside temperature shall be 5°C to 6°C less than ambient dry bulb temperature during peak summer considering all heat loads.~~

1.1.2 ESP Switchgear room

~~For the ventilation of ESP switchgear room, unitary air filtration unit is envisaged. The inside temperature shall be 5°C to 6°C less than the ambient dry bulb temperature during peak summer considering all heat loads.~~

1.1.3 Ventilation of other areas: The following areas are proposed to be ventilated by dry ventilation.

- ~~(a) D. M. Plant, CPU regeneration building, PT plant buildings~~
- ~~(b) C. W pump house~~
- ~~(c) River and Plant Raw water pump house~~
- ~~(d) Service & Administration building (other than AC areas)~~
- ~~(e) Air compressor room~~
- ~~(f) AC plant room~~
- ~~(g) D.G set room~~
- ~~(h) Battery and battery charger rooms~~
- ~~(i) Security & time house~~
- ~~(j) Canteen~~
- ~~(k) All other MCC rooms & cable vaults~~
- ~~(l) All toilets~~
- ~~(m) Stores~~
- ~~(n) Fuel oil pump house, LDO/HFO unloading pump house~~
- ~~(o) Ash water and slurry pump houses~~
- ~~(p) Clarified water pump houses & Filtered water pump houses~~

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(q) ~~Coal handling Switch gear room~~

(r) ~~Elevator machine room~~

(s) ~~All other areas not air conditioned~~

(i) ~~For all the above mentioned areas, the supply air fans/louvers and exhaust air fans/roof extractors or combination shall be provided. The ventilation system for each area shall be sized based on either air flow rate calculated considering a room temperature of 3°C (Maximum) above ambient DBT during peak summer considering all heat loads or air flow rate calculated considering minimum number of air changes / hour as mentioned else where in the document, whichever results in higher air flow rate shall be considered.~~

(t) ~~Blowdown pump house~~

1.2 ~~The following are the various Input data considered in the design of Ventilation system:~~

1.2.1 ~~Outside design conditions (sourced from the ISHRAE 1997 Handbook):~~

| | DRY BULB TEMPERATURE * | WET BULB TEMPERATURE * |
|--------------------|-----------------------------------|-----------------------------------|
| SUMMER | 45 °C | 23.9 °C |
| MONSOON | 37.2 °C | 26.7 °C |
| WINTER | 7.2 °C | 5 °C |

~~* Bidder to consider the latest prevailing outside design condition for preparation of heat load estimation.~~

2.0 ~~REFERENCE CODES AND STANDARDS~~

~~All materials and equipments provided shall comply with the following Indian Standards~~

| | |
|--------------------|---|
| IS 277 | Galvanised Steel Sheets |
| IS 325 | Three phase induction motors |
| IS 655 | Metal Air ducts |
| IS 7613 | Method of testing panel type air filters for air conditioning and Ventilation process. |

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|----------------|---|
| IS 2312 | Propeller type AC ventilation fans |
| IS 3588 | Electric axial fans |
| IS 4894 | Centrifugal fans |
| UL 555 | Fire dampers |
| IS 7098 Part-1 | Power cables |
| IS 1554 Part-1 | Control cables |
| IS 4237 | MCC |
| IS 6875 | PB Stations |
| Control panel | Individual electrical components conform to respective IS |

3.0 DESCRIPTION OF THE SYSTEMS

- a) ~~Four (4) nos. (2 nos per TG building) suitable capacity and minimum of 70 mm WC static pressure Evaporative cooling system for Ventilation of TG building and TG MCC room, switch gear, cable vault shall be provided.~~
- b) ~~One (1) no. Suitable capacity and minimum of 50 mm static pressure capacity Evaporative cooling system with Unitary Air Filtration Unit for Ventilation of ESP switch gear room and Cable spreader room is to be provided.~~
- c) ~~Ambient Air Ventilation (Dry) system for Miscellaneous areas.~~

3.1 Evaporative Cooling System for T G Building, Cable vault, switch gear and MCC room of Power house building

~~In this system, fresh filtered air is drawn through air washers and evaporatively cooled before being supplied through the supply air distribution system. The filtered air while passing through the air washers would be cooled and humidified. This cooled and humidified air is distributed by Air washer fan to different parts of the Station building through ducting would absorb the prevailing internal heat load due to equipment, piping etc. before being exhausted. Four (4) nos. of adequate capacity Spray/ Pad type air washer are to be proposed for ventilation of TG building including electrical bay, cable gallery and Switch gear rooms. For all the evaporative cooled areas the air quantity shall be based on the following Air changes per hour or heat loads whichever is higher.~~

- a) ~~TG hall - 8 Air changes / Hr~~
- b) ~~Electrical switchgear/MCC/Cable vaults - 15 Air changes / Hr~~

~~The system comprises of the following equipment :~~

- a) ~~Four (4) nos. air washer unit each of suitable capacity. (2 nos per TG building)~~
- b) ~~Each air washer comprising Two (2) no. Double Inlet Double Width (DIDW)~~

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~~type centrifugal fan of suitable capacity and minimum 70 mm WC static pressure, Two (2) nos (1 Operating and 1 standby) circulating water pumps of Horizontal split casing type / End suction top discharge type, each of adequate capacity.~~

- ~~c) Spray / Pad type Air washers with water distribution arrangement etc.~~
- ~~d) Pre filter with HDPE media having 18 G GSS frame. The efficiency of the filters shall be 90% down to 10 microns.~~
- ~~e) Inlet louvers and bird screen.~~
- ~~f) Air distribution system comprising of GSS ducting, dampers, Grilles etc~~
- ~~g) Suitable nos. of (for both TG buildings) Motor Driven Roof Extractors/ Wind Driven Turbo ventilators each of suitable capacity and minimum 15 mm static pressure mounted on TG hall roof for exhausting the hot and ventilated air.~~
- ~~h) Necessary blow down/makeup arrangement to ensure proper water quality.~~
- ~~i) Suitable nos with (for both TG buildings) adequate capacity and minimum 15 mm static pressure power Roof Ventilators mounted on TG hall roof for Exhausting the hot and ventilated air from TG hall. The hot air from Cable Gallery and Switchgear room is taken to the TG hall through Gravity dampers. Propeller fans of suitable capacity may be added to improve the performance if Required.~~

3.2 Unitary Air Filtration (UAF) Unit for Non A/C Areas of ESP Control Building

~~UAF unit shall consist of intake louvers, filters, Evaporative cooling pads, sump tank, circulating water pumps, piping and valves, eliminators, centrifugal fans, outlet damper and plenum section. The entire components stated above shall be neatly arranged and skid mounted and provided with GI sheet enclosure of adequate thickness. Each section i.e., filters, Evaporative cooling pad and pump section etc. to be provided with access door for maintenance, fans and all other components shall be supported on properly designed beams/l sections. For the fan discharge duct as well as fan section accordingly sizing to be done on the inside so as to limit the noise level to 85dB within 1 m of the fan room enclosure. On the whole the assembly of UAF should be designed so as to be structurally sound, air tight and also aesthetically pleasing.~~

~~In this system, fresh filtered air is drawn through UAF and evaporatively cooled before being supplied through the supply air distribution system. The filtered air while passing through the air washers shall be cooled and humidified to minimum 70% saturation efficiency. This cooled and humidified air when supplied to Switch gear area would absorb the prevailing internal heat load due to equipment before being exhausted. One (1) no. Suitable capacity UAF are to be proposed for ventilation of ESP / VFD control building Non A/C areas.~~

~~The hot air from the of ESP control building Non A/C areas shall be exhausted by means of gravity dampers.~~

~~The system comprises of the following equipments :~~

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~~j) One (1) no. UAF unit of suitable capacity and minimum 50-mm static pressure complete with all components and accessories with the entire components neatly arranged and skid mounted and provided with GI sheet enclosure of adequate thickness.~~

~~k) Packaged air washer unit comprises of One (1) no. Double Inlet Double Width (DIDW) / Single Inlet Single Width (SISW) type centrifugal fan of suitable capacity, Two (2) nos (1 Operating and 1 standby) circulating water pumps of Horizontal split casing type / End suction top discharge type, each of adequate capacity, Evaporative cooling pads, piping, valves, Pre filter with HDPE media and efficiency 90% down to 10 microns, Inlet louvers, Drift eliminators and bird screen.~~

3.3 **Ambient Air Ventilation (DRY) System for Miscellaneous Areas**

3.3.1 For Ventilation of other miscellaneous areas, the ambient Mechanical Ventilation (dry) system shall be designed to maintain Dry bulb temperature not exceeding 3⁰ C above ambient dry bulb temperature in peak summer. The air quantity shall be arrived based on number of air-changes/hr, or heat loads whichever results in higher air flow rate as indicated below.

- DG house: 40 air-changes/hr.
- Switch gear room & cable volt room: 25 air-changes/hr.
- All other areas 15 air-changes/hr.

3.3.2 All other areas as mentioned in clause 1.1.3, shall be provided with supply system comprising supply air fans or supply air intake louvers (without fan) and exhaust system comprising wall mounted exhaust fans OR roof extractors mounted on the roof of the respective building, depending upon the layout of the building. The type of system is detailed under Appendix-III.

3.3.3 For Battery rooms, air intake is through louvers and exhaust by means of 20G MS Epoxy painted ducted exhaust by exhaust fans shall be provided. Higher exhaust air flow rates compared to supply air flow rate shall be maintained within the Battery room to maintain negative pressure. All fans, motors, ducting and grilles in this area shall be given acid proof treatment and epoxy painted. The fans shall be of anti spark construction with flame proof motors. Each battery room shall be provided with 2 nos. exhaust fan each of 50% capacity.

3.3.4 Pressurised Ventilation for Switchgear rooms / MCC rooms & cable gallery: Filtered air is supplied to Switchgear rooms / MCC rooms through ducting and grilles by means of supply air fan and the air is exhausted through gravity dampers, propeller fans of suitable capacity will be added if necessary. Supply air shall be higher than exhaust air to maintain positive pressure in side.

3.3.5 For elevator machine room, filtered air shall be supplied by supply air fan. Exhaust shall be through gravity dampers.

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4.0 **EQUIPMENT TO BE SUPPLIED**

4.1 **Air Washer for TG Building**

~~Design wet bulb temperature : 26.7 °C
Saturation efficiency: 90%~~

~~Each Air washer comprises of the following :~~

- ~~a) Two (2) no. (2x50% capacity) Double Inlet Double Width (DIDW) type centrifugal fan of suitable capacity and complete with drive package and motor.~~
- ~~b) Two (2) nos (1 Operating and 1 standby) circulating water pumps of Horizontal split casing type, each of adequate capacity~~
- ~~c) Spray chamber with double banks spray nozzles, flooding nozzles, distribution plates, moisture eliminator assembly, etc.~~
- ~~d) Pre filter with HDPE filter media~~
- ~~e) Inlet louvers with bird screen.~~
- ~~f) Sump complete with make-up connection, over flow connection, drain connection and water level switch.~~
- ~~g) Controls comprising the following:~~
 - ~~• Sump Level switch, to trip pump at low water level in the sump.~~

4.2 **Unitary Air Filtration Unit (UAF)**

~~Design wet bulb temperature : 26.7 °C~~

~~Minimum Saturation efficiency: 70%~~

~~The UAF comprises of the following :~~

- ~~a) One (1) no. DIDW / SISW type centrifugal fan of capacity suitable capacity and complete with drive package and motor.~~
- ~~b) Two (2) nos (1 Operating and 1 standby) circulating water pumps of each of adequate capacity~~
- ~~c) Evaporative cooling Pad with water distribution arrangement etc.~~
- ~~d) Pre filter with HDPE filter media.~~
- ~~e) Inlet louvers and bird screen.~~
- ~~f) Sump complete with make-up connection, over flow connection, drain connection and water level switch.~~
- ~~g) Controls comprising the following:~~

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- Sump Level switch, to trip pump at low water level in the sump.

4.3 **Centrifugal water pump set**

The centrifugal pump set will be Horizontal split casing / End suction top discharge centrifugal pump set and each centrifugal water pump set shall comprise of the following :

- One (1) no. Horizontal split casing centrifugal pump.
- One (1) no. adequately sized Induction motor suitable for 415 V, 3 phase, 50 Hz supply.
- One (1) set of base plate, coupling guard, anti vibration pads and foundation bolts.
- Flexible connection between pump and piping.
- Drain piping from pump to nearest floor drain

4.4 **Centrifugal Fan**

The centrifugal fan shall be designed for :

- Fan RPM : Not exceeding 1000 RPM
- Fan type : Backward curved DIDW / SISW
- Fan outlet Velocity: Not exceeding 12 m/s.

Each centrifugal fan comprises of :

- One (1) no. adequately sized Induction motor suitable for 415 V, 3 phase, 50 Hz supply with drive package comprising of fan pulley and V-belt.
- Common base frame with spring type vibration isolators.
- Inlet guard, outlet damper and flexible connection between duct and fan

4.5 **Axial fan**

The Axial fan shall be designed for :

- Fan type: Tube Axial / Propeller.
- The impeller shall have blades of an aerofoil design.
- The speed of the fans shall be 1500 rpm for impeller diameter 450 mm or less and 1000 rpm for impeller diameter above 450 mm.

Axial fans will be of propeller type, for fans with 5 mm of wc fan static pressure and Tube Axial type for fans with static pressure above 5 mm of wc.

Each Axial fan comprises of fan, fan motor, inlet and outlet cone (for Tube axial), Louvered shutter (exhaust fans), bird screen and supporting arrangement.

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4.6 Power Roof Extractor

~~The Power Roof Extractor shall be designed for :~~

- ~~i) Fan type : Tube Axial~~
- ~~ii) The impeller shall have blades of an airfoil design~~
- ~~i) The speed of the fans shall be 1500 rpm for impeller diameter 450 mm or less and 1000 rpm for impeller diameter above 450 mm.~~
- ~~ii) Hood shall be hinged type.~~

~~Each Power Roof Extractor comprises of fan, fan motor, hood with disconnect switch and supporting arrangement.~~

4.7 Air distribution system

- a) Rectangular Duct: GSS supply air ducting and return air ducting with Zinc coating 200 Gms /sq.m or better.
- b) The supply air ducting will be designed based on equal friction method to have an initial velocity not exceeding 11 m/s and friction rate 0.8 Pa/m.
- c) The exhaust air ducting will be designed based on equal friction method to have an initial velocity not exceeding 9 m/s and friction rate 0.66 Pa/m.
- d) Supply air grilles will be with volume control damper
- e) Return air grilles will be without volume control damper
- f) Neck velocity for supply air grille and return air grille shall be 2.5 m/s (max).
- ~~g) Fusible link type fire dampers shall be provided in the supply air ventilation duct and return air ventilation duct crossing wall / floor.~~

4.8 Piping and Valves

- a) Piping shall be
 - ERW, Black, IS-1239 heavy class for pipe sizes up to 150 NB
 - ERW, IS 3589 fabricated from IS 2062 plates for pipe sizes 200 NB-450 NB
- b) Isolating valves will be butterfly valve type for valve size 50 NB and above.
- c) Isolating valves will be Gate valve type for valve size below 50 NB.
- d) Strainers will be Pot strainer type
- e) Air washer circulating water piping shall be designed such that, for pipe sizes of 50 NB and under, maximum velocity is 1.2 m/s and friction rate is not exceeding 250 Pa/m. For pipe sizes above 50 NB, maximum velocity is 3 m/s and friction rate is not exceeding 400 Pa/m.

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f) Isolating valves will be provided at inlet and outlet piping of pumps.

g) Strainers will be provided at the inlet piping to pump.

h) Non return valves will be provided at the outlet of Pumps.

4.9 **Pressure gauge**

Direct reading, pipe mounted Dial type Pressure gauges with Six (6) inch phenolic dial (White dial with black numerals) and will be provided at One each at Suction and discharge side of the pump set.

4.10 **Temperature gauge**

Direct reading, field mounted Six (6) inch dial (White dial with black numerals) temperature gauge and will be provided at Air washer circulating water pump discharge header.

4.11 **Louvers / Wall Cowl with bird screen**

Louver / Wall Cowl with bird screen will be provided for supply air inlet and for exhaust with Tube Axial fans. The louvers shall consist of parallel metallic blades. For louvers, the minimum projected width of blades in horizontal plane shall be 150mm with the blades inclined at minimum 35 degrees. Design face velocity for louvers is 2.5 m/s.

Bird screen of 10 sq.mm and minimum 16 G wire mesh is provided on the outer face of Louvers.

5.0 **CONTROL PHILOSOPHY FOR VENTILATION SYSTEM**

~~5.1 PLC based control system shall be envisaged for air washers ventilation system. All the air washers PLC shall be interfaced with the main control system for monitoring.~~

~~5.2 Following control function are to be proposed:~~

~~5.2.1 Tripping of Air washer circulating water pumps at low water level in the air washer sump.~~

~~5.2.2 Annunciation on the status of Run/trip status of Air washer pumps and Air washer fans.~~

~~5.2.3 Air washer pump and fan shall be provided with local lockable start/stop push button.~~

~~5.2.4 Air washer shall be interlocked with fire protection system to trip under fire condition and associated solenoid operated fire dampers shall close~~

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6.0

MATERIAL OF CONSTRUCTION

6.1 Air Washer Internals

- Evaporative pad : Cellulose material chemically treated for antiriot and rigidifying resins.
- Evaporative pad casing : GSS or Fibre Reinforced Plastic
- Suction screen : 24 G brass

6.2 Centrifugal Pump Set:

- Casing : Cast iron, IS:210 Gr. FG 260
- Impeller : Bronze IS 318 Gr 2
- Shaft : EN 8
- Base plate : Fabricated MS

6.3 Air Distribution system:

- Ducting : GSS Zinc coating 200 gms /sq.m or better
- Grille : MS painted complete with supporting framework.
- Volume control damper blade & frame : 18 G GSS
- Fire damper blades and frame : 16 G GSS
- Louver Frame : 16 G GSS
- Louver Blade : 20 G GSS

6.4 Piping and Valves:

- Pipe sizes up to 150 NB : ERW, Black, IS-1239 heavy class
- Pipe sizes 200 NB to 450 NB : ERW, IS 3589 fabricated from IS 2062 plates
- Valves 50 NB and Below : Gun metal construction or Bronze
- Valves above 50 NB : Cast Iron, IS 210 Gr FG 260

6.5 Centrifugal Fan:

- Casing : Mild steel sheets / plate to IS 2062
- Impeller : Mild steel sheets / plate to IS 2062
- Shaft : EN 8
- Outlet damper : GSS
- Fan supports, frames and structure : Mild steel plate to IS 2062

6.6 Axial Fan:

- Casing : Mild steel plate to IS 2062
- Impeller : Cast Aluminium
- Shaft : EN 8
- Inlet Cone / Outlet cone : Mild steel

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6.7 **Roof Extractor:**

- Casing : Mild steel plate to IS 2062
- Impeller : Cast Aluminium
- Shaft : EN 8
- Hood : MS

6.8 **Pre filter & Fine Filter:**

- Filter Media : High Density Poly ethylene (HDPE)
media.
- Frame : 18 G GSS

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(APPENDIX III)

The type of Ventilation system to be provided

| SL.NO | NAME OF AREA | TYPE OF VENTILATION SYSTEM | SUPPLY AIR SYSTEM | EXHAUST AIR SYSTEM |
|-------|--|---|---|---|
| 1 | TG Building | Evaporative cooling system | From Air washer through ducting | Roof extractors / exhaust fans |
| 2 | Cable gallery and switch gear room of TG building | Evaporative cooling system | From Air washer through ducting | Gravity dampers/propeller fans |
| 3 | Non AC areas of ESP control room | Evaporative cooling system | From Unitary air filters through ducting | Gravity dampers |
| 4 | DM plant | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans |
| 5 | C-W Pump House | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans |
| 6 | River and Raw water pump house | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans |
| 7 | Administration building | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans |
| 8 | Air compressor room | Ambient Air Ventilation (DRY) System | Filtered air supplied by supply air fan | Gravity dampers |
| 9 | AC plant room | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans |
| 10 | D.G set room | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans / Roof extractors |
| 11 | Battery and battery charger rooms | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans with ducting |
| 12 | Security and time house | Ambient Air Ventilation (DRY) System | Fresh air through door Louvers/door under cuts | Exhaust fans |
| 13 | Canteen | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans |

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| SPEC. NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME: III SECTION: D12 |
| PART – B | RRVUNL, 2x660 MW, Super-Critical TPS, Stage-V Unit # 7 & 8 at Suratgarh, Rajasthan AIR-CONDITIONING & VENTILATION | SHEET 28 OF 28 |

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| 14 | All MCC room & cable vaults | Ambient Air Ventilation (DRY) System | Filtered air supplied by supply air fan | Gravity dampers |
| 15 | Toilets of all buildings | Ambient Air Ventilation (DRY) System | Through door undercuts/door louvers | Exhaust fans |
| 16 | Stores | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans |
| 17 | Fuel oil pump house, LDO/HFO | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans |
| 18 | Ash water pump house, Slurry pump house | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans |
| 19 | Clarified / Filtered water pump house | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans |
| 20 | Coal handling Switch-gear room | Ambient Air Ventilation (DRY) System | Filtered air supplied by supply air fan | Gravity dampers |
| 21 | Elevator machine room | Ambient Air Ventilation (DRY) System | Filtered air supplied by supply air fan | Gravity dampers |
| 22 | Blow down pump house | Ambient Air Ventilation (DRY) System | Fresh air through Louvers | Exhaust fans |

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SECTION D9

**415V SWITCHGEAR/POWER
DISTRIBUTION BOARD/MCC**

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| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan 415V SWITCHGEAR/ DISTRIBUTION BOARDS/MCC | SHEET 1 OF 16 |

1.0 415 V Switchgear, PMCCs and MCCs required for feeding the all the entire Plant Loads (except River water System) shall be supplied. These shall include as a minimum the following boards for 2 Units:-

- a) Turbine PCC
- b) Turbine MCC
- c) Boiler PCC
- d) Boiler MCC
- e) Soot blower MCC
- f) ESP MCC
- g) Mill MCCs
- h) TVDB
- i) BVDB
- j) Hydrogen Plant MCC
- k) AC & DC distribution boards
- l) AC & ventilation MCC
- m) Normal emergency switchgear
- n) DC Switchgears
- o) Emergency Switchboards (D.G)
- p) Cooling Tower MCCs.
- q) Intake Water MCCs.
- r) Ash handling Plant PMCC
- s) Ash water/Silo/Slurry MCC- As required.
- t) Fly Ash MCC- 3 Nos.
- u) Ash dyke MCC
- v) Coal Handling Plant MCCs- As required
- w) Wagon tippler MCCs- One MCC per Wagon tippler.
- x) Bunker Floor PMCCs- As required
- y) Water system switchgear.
- z) DM Plant MCC
- aa) Chemical House MCC
- bb) River water MCC
- cc) Electro Chlorination Plant MCC.

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| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan 415V SWITCHGEAR/ DISTRIBUTION BOARDS/MCC | SHEET 2 OF 16 |
| <p>dd) Clarified water MCC</p> <p>ee) Effluent treatment plant MCC</p> <p>ff) Guard Pond MCC</p> <p>gg) LDO MCC</p> <p>hh) HFO MCC</p> <p>ii) Fuel oil unloading PH MCC A, B</p> <p>jj) Switchyard PMCC A, B.</p> <p>kk) Station switchyard auxiliary swbd PMCC 1 , 2</p> <p>ll) Fire water PH switchgear 1A,1B.</p> <p>mm) Site office switchgear.</p> <p>nn) Compressor MCC 1A,1B</p> <p>oo) Air washer MCC 1A, 1B.</p> <p>pp) C.W Pump House MCC</p> <p>qq) Station ACDB 1A,1B.</p> <p>rr) Work Shop MCC</p> <p>ss) Admin building PCC</p> <p>tt) Service building AC and Ventilation MCC</p> <p>uu) ESP Control Room AC and Ventilation MCC</p> <p>vv) Receptacle Welding DBs.</p> <p>ww) Space Heater DB – As required.</p> <p>1.1 415 V systems shall be 3 phase, 3-wire, solidly grounded system except for those listed in cl.no.1.2 which shall be with 4-wire system. All MCC shall derive power from power source as per Key One line diagram 5750A-738-AU-3001 attached.</p> <p>1.2 Following PCC/MCC/Distribution Boards shall be of 4-wire type. Incomer and bus coupler SFU/MCCB/ACB of all 4 wire PCC/MCC/DB shall be of 4 pole type:</p> <p>a) Welding receptacle DBs</p> <p>b) Space Heater DBs</p> <p>c) Workshop MCC</p> <p>d) Admin building MCC</p> <p>e) Site Office switchgear</p> <p>f) Service building and Ventilation MCCs</p> | | |
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g) Station building DBs

h) Switchyard DBs

i) All PCCs

1.3 For codes & standards refer section D28 of this volume.

2.0 **FEEDER DETAILS**

2.1 Each of the switchgear shall be provided with two bus sections, two incomers and a bus coupler each rated for 100% of the loads connected to the switchgear.

2.2 The switchgears shall be provided with suitable number and type of outgoing feeders for the respective auxiliary loads of the system/area. Additionally following shall be provided in all Switch boards.

(a) Spare feeders:

- 4 Nos. of 400A outgoing feeders shall be provided in station auxiliary service switchgear for Owner's use by the EPC Contractor scope.
- In addition, 20% spares of each rating and type of module shall be considered with a minimum of one number. Any additional quantity required for any increase/ changes during detailed engineering stage shall also be duly considered.

(b) Bus VT module – 1 per bus section.

(c) Control transformer module – 1 per bus section. Where there is no bus section (only one bus) and for the N/E Switcgear bus section, 2 nos. Control Transformers are to be provided. Control transformers shall be located in Physically separate modules. Each Control transformer shall be sized for complete load of the Switchgear/MCC. i.e., Control Transformers shall be of 2 X100 % capacity with manual and auto changeover facility in case of any one Transformer supply failure.

(d) 240V, 1 phase space heating. 1 per bus section.

(e) Control supply (AC and DC) changeover scheme module.

(f) Each bus section shall have the following feeders for Purchaser's use:

32A – 3 Nos.

63A – 2 Nos.

100A – 2 Nos.

160A – 2 Nos.

(g) Essential / critical loads to receive supply from the Normal-Emergency Switchgear and 220V DCDB.

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3.0 SHORT CIRCUIT CURRENTS

- 3.1 The fault level on the 415V buses shall be calculated based on transformer contribution and motor contribution and shall be limited to 50kA inclusive of 10 % margin. The minimum short time current rating shall be 50 kA for 1 second.
- 3.2 It is the responsibility of the Vendor to co-ordinate operation of all the ACBs and MCCBs for short circuit condition so that discrimination in operation is provided. Co-ordination and relay setting is in Vendor's scope.

4.0 CONTINUOUS CURRENTS

The continuous current rating of the bus bars, the incomers, bus couplers of the switchgear, which are fed by the transformers shall be rated at the LV side full load current of the corresponding transformers with 20% margin rounded off to the next higher standard rating.

5.0 SPECIFIC REQUIREMENTS

- 5.1 All the 415V equipments/devices like bus support insulators, CBs, CTs, PTs etc mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions.
- (a) Variation in supply voltage $\pm 10\%$
 - (b) Variation in supply frequency $\pm 5\%$
 - (c) Combined voltage and frequency variations: 10% absolute.
- 5.2 All bus bar, bus-taps shall be insulated with close fitting sleeve of PVC insulation with high dielectric strength.
- 5.3 The switchgears shall be totally enclosed, metal clad, sheet steel fabricated, indoor, floor mounted fully draw-out modular type construction, dust and vermin proof of uniform height of not more than 2450mm, easily extendable on one side having switchgear designation indicating label's on front and rear, in single/ double front execution in totally draw out. Proper gasketing shall be provided all around the perimeter of the adjacent panels, panel and base frame, removable cover and doors. The switchboard shall be fully compartmentalized. Incomers to the switchgear shall be of cable/ Non-segregated phase busbuct. The switchgear shall be capable for the suitable termination.
- 5.4 Operating devices shall be incorporated only in front of the switchgear.
- 5.5 Switchgear shall be divided in to distinct vertical section consisting of :-
- (a) Completely Enclosed busbar compartment running horizontally.
 - (b) Individual feeder modules in multi tier arrangements.
 - (c) Enclosed vertical bus bars serving all modules in vertical section.

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| <p>(d) Vertical cable alley covering entire height and minimum 300 mm wide and shall have hinged doors.</p> <p>(e) A horizontal separate enclosure for all-auxiliary power and control bus as required.</p> <p>5.6 All modules of identical size & type shall be fully interchangeable without any modifications.</p> <p>5.7 The sheet steel to be used for the metal enclosed switchgear shall be minimum 2.5 mm thick hot rolled or 2 mm cold rolled.</p> <p>5.8 The cable entry shall be bottom/top with separate gland plate for power and control cable. In case of single core cables, gland plate shall be of non magnetic material. The exact cable entry shall be finalised during detailed engineering.</p> <p>5.9 All Air circuit breakers (ACBs) and Moulded case circuit breakers shall be of short circuit performance category P2 as per IS:2516 Parts I & II.</p> <p>5.10 The MCCBs shall be of current limiting type. When MCCB's are used as short circuit protection devices for motor modules they shall provide type C co-ordination with associated contactor and thermal overload relay as per IS: 8544 under all operating conditions for the all currents up to the design fault current. The MCCBs on upstream and downstream shall be co-ordinated.</p> <p>5.11 Test reports to prove the requirements of Type-C Co-ordination shall be furnished.</p> <p>5.12 There shall be two number 220V DC control supply for each switchgear. Auto and manual changeover scheme for changeover of supply- 1 to 2 and vice versa shall be provided. Necessary voltage monitoring contactors (for remote alarm) and indication lamps shall be provided.</p> <p>5.13 Minimum of one NO and one NC spare contacts of all contactors, relay devices shall be wired to terminal block. All spare contacts of all contactors relay terminals shall be wired up to the terminal block.</p> <p>5.14 For CT & VT circuits disconnecting type of terminals shall be provided.</p> <p>5.15 Power cable terminal arrangement and size shall be suitable to accommodate two or more number of cables based on requirements and shall facilitate easy maintenance.</p> <p>5.16 Terminal arrangements shall be such that all terminals at switchgear ends, which are to be connected to remote alarms and indication at DCS, shall be separated out and shall be kept isolated from other Terminals. 240V AC, 110V AC, 24V DC, 220V DC & other voltages shall be segregated to avoid mix up of voltages. This is specifically required to avoid mixing of switchgear high voltage to C & l low voltage system.</p> | | |
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- 5.17 Meters shall be Digital type. For MCC verticals, CT pertaining to a particular module should be mounted in the respective with drawable module it self. CT should not be mounted in cable alley.
- 5.18 Switchgear shall be suitable for easy extension on one side. It shall be possible at a later stage to add cubicles to the switchgear by extending the bus bars.
- 5.19 Secondary of CTs & VTs shall be made through disconnecting type terminals with necessary shorting and earthing facilities. All the control wiring shall be through stud type terminal.
- 5.20 The breaker ratings indicated in the data sheets referred to the nominal rating of the breaker. However, Breakers shall be capable of carrying continuously at least 120% of circuit breaker current at an ambient temperature of 44 deg. and with breaker mounted inside the panel. If a higher rated breaker is necessary to meet this, the same shall be used.
- 5.21 Dummy cubicles with horizontal bus bars, power control and annunciation cable running through the panel, if necessary, to avoid beam interfering with cable openings and to facilitate easy maintenance shall be provided.
- 5.22 All the bolted joints in body of the switchgear shall be earthed through flexible jumpers.
- 5.23 All indicating and integrating instruments, protection and alarm relays , operating and indicating devices shall be visible/ accessible without opening the instrument compartment door. All the hand reset relays shall be mounted on the panel at a conventional height for operation.
- 5.24 All the internal wiring shall be carried out using 1100V grade, stranded copper conductor with PVC insulation and shall be flame, vermin and rodent proof. The minimum size of the copper conductor used for panel wiring shall be as follows:
- All circuit except CT &PTs: 1.5 sq mm per lead.
 - CTs/PTs : 2.5 sq mm/per lead.
- 5.25 The minimum number of strands per conductor shall be 07. Double flexible wire shall be used for internal wiring of devices mounted on moving parts of Cu conductor of size as mentioned at a) & b) above.
- 5.26 Following colour coding shall be used for internal wiring:-
- Red, Yellow & Blue: For respective phase /PT wires.
 - Black : for neutral wires.
 - Green : For Earth wires
 - Red ferruled wires for trip circuit.
 - All other with grey coloured wires.

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| <p>5.27 The inter panel wiring shall be brought out to a separate set of terminal blocks located near the slots meant for inter panel connecting wires.</p> <p>5.28 At least 20% spare spare terminations of CT, PT & others shall be provided on each panel'. and these spare terminals shall be uniformly distributed on all rows of terminal blocks. A clearance of 250 mm shall be maintained between terminal blocks and gland plate and 150 mm between two rows of terminal blocks. at least 20%</p> <p>5.29 All the electrical equipment shall be fed from main MCC only and if any specific arrangement is needed, separate panel for that shall be provided in switchgear room.</p> <p>5.30 All LT panels shall be mounted at least on ISMC (Indian Standard Medium Channel) or other applicable 100 channels to prevent ingress of water.</p> <p>5.31 All hardware required for meeting the functional requirements stated above, whether specifically listed out in the specification or not, shall be included in the scope of supply.</p> <p>5.32 Current transducers, power transducers and Voltage transducers shall be provided.</p> <p>5.33 The cable terminations inside the cable alley shall be completely shrouded so that it shall be possible to work on any one of the terminations by switching OFF the corresponding feeder switch only.</p> <p>5.34 All bezels, handles, screws, bolts, washers, hinges, etc. shall be of the best quality electro galvanized or passivated to withstand attach from corrosive atmosphere.</p> <p>5.35 Horizontal busbar chambers shall be at the top of the board for bottom cable entry. Busbars shall be completely shrouded to prevent metal pieces falling on the busbar during maintenance.</p> <p>5.36 In case of copper to aluminium connections, proper treatment shall be given to minimise the bimetallic effect. That is, all joint surfaces at aluminium to copper joints shall be silver / tin plates, alternatively Cu-Al washers (bimetallic washers) can be used..</p> <p>5.37 On- line energy monitoring system shall be provided on all drives above 80kW rating which will help in preventive maintenance.</p> <p>5.38 All MCC feeders of 80kW and above rating shall have Ampere,kVA, kW transducers for communicating the data to PLC system for auxiliary consumption analysis.</p> <p>5.39 Outgoing feeders of rating 200A and above upto 630A (other than motor feeders) shall have MCCBs only with Short-circuit and Earth fault protection. Feeders of rating less than 200A shall be SFU. This is not applicable for feeders feeding other MCCs and switchboards.</p> | | |
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- 5.40 Welding Distribution Boards shall be provided with the following:
- a) It shall be with isolating transformer on the incomer with ACB with Over current and Earth fault protections.
 - b) It shall be provided with maximum 12 nos. Of outgoing feeders.
 - c) Quantity of Welding receptacles:
 - (i) One (1) no. in each ESP and Boiler Platform.
 - (ii) One (1) no. every 50m in each floor of TG building.
 - (iii) Two (2) nos. each in every building in the power plant other than Admin Building.
 - (iv) One (1) no. for every 60M in Switchyard and Main Transformer yard.
 - (v) Looping of welding receptacles not allowed.

6.0 **INCOMERS & BUS COUPLERS.**

- 6.1 Incoming/ Bus coupler/ Outgoing feeders of rating 200A and above up to 630A (other than motor feeders) shall have MCCBs only with Short-circuit and Earth fault protection. Feeders of rating less than 200A shall be SFU. Feeders rated above 630A shall have ACBs.
- 6.2 The following minimum protections shall be provided for incomers and bus coupler for switchgears.
- phase inverse time over current relays
 - Earth fault relay (for incomer only)
 - Numerical relays shall be provided for all protection.
- 6.3 The incomer modules & bus coupler modules of PMCC as well as important MCC's as mentioned in clause 6.5 irrespective of loads shall be equipped with fully draw out air circuit breaker protected with relays.
- 6.4 All incomers and outgoing feeders of various loads shall have digital energy meter for energy accounting. The energy Meters of Incomers shall be of the Tri Vector Meter type (TVM) with recording and download facility.
- 6.5 Important MCCs shall be controlled from remote DCS & ECP. They shall be with ACBs, closing coil, shunt trip coil and relays irrespective of the current ratings.
- 6.6 The incomer modules shall be interlocked with their upstream breaker such that they can be closed only when upstream breaker is closed and trip automatically when upstream breaker is tripped.
- 6.7 Each circuit breaker cubicle shall be complete with following minimum accessories:-

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| <p>a) One spring return Trip normal close (TNC) switch.</p> <p>b) Large size cluster LEDs for following condition of breaker/contactors:-</p> <ul style="list-style-type: none"> (i) "ON"(Red) (ii) "OFF" (Green) (iii) Trip relay supervision (White). (iv) Spring charged (Blue) (v) DC supply supervision (Violet) (vi) Trip on fault (Amber) <p>c) Limit switches for test and service position interlocking.</p> <p>d) Double pole switch for DC control supply and spring charging motor with HRC fuses or MCB will be provided (Fuse or MCB shall be provided for DC control supply which shall be decided during detailed engineering).</p> <p>e) Anti pumping relay.</p> <p>f) Sufficient terminal blocks.</p> <p>g) Auxiliary relays as required for contact multiplication.</p> <p>h) Breaker operation counter.</p> <p>i) Numerical Protective relays along with trip circuit supervision relay and master trip relay.</p> <p>j) Meters as indicated elsewhere.</p> <p>k) Required CTs/PTs.</p> <p>l) Space heaters.</p> <p>m) One Local/Remote Switch.</p> <p>n) Required number of 24 V DC DC Interposing Relays.</p> <p>o) 4-20 mA output Transducers for current, power and voltage.</p> <p>p) Other associated equipment.</p> <p>6.8 All the circuit breakers shall be of fully draw out execution with "Test", "Service " & " Fully withdrawn " positions.</p> <p>6.9 Double tier arrangement shall not be provided for incomers and bus coupler. In case of motor feeders, double tier arrangement may be provided but two breakers of same application motor shall not be provided in one vertical.</p> <p>6.10 Breakers shall be with motor wound spring operating mechanism, 220 V DC operated Closing and tripping coils.</p> <p>6.11 Closing action of the CB shall compress the opening spring ready for tripping.</p> | | |
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| <p>6.12 Proper mechanical indication shall be provided to locate these three positions without opening of the compartment door.</p> <p>6.13 It shall be possible to bring the circuit breaker to isolated position with the help of external lever without opening the compartment door.</p> <p>6.14 A stop block shall be provided on the slide rails to prevent the movement of the circuit breaker out of the compartment when it reaches the isolated position so that any accidental fall can be avoided.</p> <p>6.15 No control & metering equipments should be mounted on breaker compartment door (i.e access to control & metering equipments should be available at all time without opening Breaker Compartment door).</p> <p>6.16 It shall not be possible to close the Breaker if stored energy mechanism is not charged.</p> <p>6.17 In case of MCCBs, it shall not be possible to close the Breaker if under-voltage relays release is not energised (if present).</p> <p>6.18 Movement of the circuit breaker truck from service to test or test to isolated position OR in reverse order shall be possible only when circuit breaker is off.</p> <p>6.19 It shall not be possible to withdraw the breaker when it is in closed position.</p> <p>6.20 Opening of compartment door with breaker / isolating switch in Service & Intermediate and ON position and vice versa shall not be possible.</p> <p>6.21 It shall not be possible to close the Breaker if closing coil is energized.</p> <p>6.22 It shall not be possible to close the Breaker if OFF – Push Button is locked in off position.</p> <p>6.23 It shall not be possible to close the Breaker if crank hole is open.</p> <p>6.24 The Circuit Breaker shall be provided with mechanical ON/OFF, TRIP and SPRING CHARGED, DISCHARGED READY TO CLOSE AND BREAKER POSITION indication, mechanical trip push button.</p> <p>6.25 The circuit breaker shall be provided with automatic safety shutters, so that before the breaker reaches 'isolated' position the main isolating contacts are completely shrouded. In the draw-out condition, it shall be possible to inspect the Breaker fixed contacts condition by lifting the shutters.</p> <p>6.26 The protective relays and instruments shall be mounted in separate compartment. This compartment shall be along side and immediately next to the controlled breaker</p> <p>6.27 Contact erosion indicator shall be provided on Moving contacts of Breaker for visual indication of contact life.</p> <p>6.28 All the non conducting metal parts of the circuit breaker trolley shall be bonded together and shall make perfect electrical connection to earth through substantial sliding contacts, at service and test positions. Such sliding</p> | | |
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contacts shall be arranged to make before power plug in and interrupt after power draw out.

7.0 **BUS AND LINE PTs**

Bus PT over voltage factor shall be 1.9 for 08 hours. 3 Nos. single phase PTs shall be connected up to form a 3 phase unit.

Each PT cubicle shall be complete with following minimum accessories

- (a) PTs shall be fully draw out type with required no of cores and ratios as specified elsewhere.
- (b) Voltmeter with selector switch.
- (c) Separate Under voltage (2 nos.) and No voltage relays (2 nos.) with timers and fuse fail relays.
- (d) Required auxiliary relays.
- (e) LEDs for voltage indication.
- (f) Auxiliary PTs, as required.
- (g) DC and AC control supply and changeover switches with Short Circuit protection.

8.0 **MOTOR MODULES**

8.1 All LT motors shall be controlled as follows:

- a) Up to 50kW: - MPCB + Contactor (MPCB shall be with adjustable S/C and O/L protection).
- b) 50kW to 90kW shall have MCCB+ contactor+ bimetallic relay.
- c) 90Kw to 160kW shall have ACB +motor protection relay (MPR).

8.2 All motor feeder shall be complete with following minimum accessories.

- (a) Interlocking schemes for Space heating arrangements (space heating for motors above 30KW).
- (b) 3 position selector switch-Local (switchgear)/Field/Remote (DCS/PLC)
- (c) Test services position switches and associated contactors for interlocking.
- (d) Power contactors and MPCB or breaker.
- (e) Bi-metal relay or Motor Protection relay.
- (f) CTs as specified elsewhere.
- (g) Local indication lamp for ON, OFF & TRIP/Fault indication.

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| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan 415V SWITCHGEAR/ DISTRIBUTION BOARDS/MCC | SHEET 12 OF 16 |

- (h) Relays as required.
- (i) ON & OFF PBs, for testing in Test Position.
- (j) 24 V DC Interposing relays to accept remote start and stop signals .

8.3 All the motors rated 30 kW and above shall be provided with a CT, ammeter and a current transducer with remote metering in DCS. Further important motor like ID/FD/PA fan, LOP motors, HP/LP bypass motor, mill feeders motor, APH motor, air conditioning motor etc shall also be provided with CT, ammeter and a current transducer with remote metering in DCS irrespective of kW.

8.4 The incomer/bus coupler, module, MPCB/MCCB feeder etc shall confirm to the attached M2 series of schematic drawings.

9.0 **ACTUATORS.**

All actuators to be supplied with non integral starters.

10.0 **METERING.**

10.1 Each incomer feeder to all PMCC/PCC/MCCs shall have Voltage, Ampere, kVA, kW, transducers for communicating the data to DCS/PLC system for auxiliary consumption analysis and these parameters voltage, current, kW and kVA of each incomer also shall be available on respective ECP.

10.2 Meters shall be Digital type. All CT s/ PT s, transducers and meters (Energy accounting and audit meters) on 415 V system shall be class 1.0. Metres for motor feeders shall be with suppressed scale.

10.3 All MCC feeders (except motor feeders) of 80kW and above rating shall have Ampere, kVA, kW transducers for communicating the data to DCS/PLC system for auxiliary consumption analysis.

10.4 All the motors rated 30 kW and above shall be provided with a CT, ammeter and a current transducer with remote metering in DCS. Further important motor like ID/FD/PA fan, LOP motors, HP/LP bypass motor, mill feeders motor, APH motor, air conditioning motor etc shall also be provided with CT, ammeter and a current transducer with remote metering in DCS irrespective of kW.

10.5 The Energy accounting and audit meters as required by CEA shall be on a separate core and shall be installed at following locations to facilitate the accounting of the energy generated, transmitted, distributed and consumed in various segments of the power system and the energy loss, namely

- Low voltage side of each incoming transformer feeder of low voltage (415V) buses, and

This CT core and the meters shall have an accuracy of 0.2S for this purpose and PT cores shall have an accuracy class of 0.2 for this purpose.

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| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan 415V SWITCHGEAR/ DISTRIBUTION BOARDS/MCC | SHEET 13 OF 16 |

11.0 **ALARMS/INDICATION/SER POINTS**

11.1 **INCOMERS AND BUSCOUPLER CONTROL.**

11.1.1 Incomers/Bus couplers/Ties from/to the various Switchboards (with ACB and MCCB as incomers) listed in Clause 1.0 shall be controlled from DCS/PLC (as applicable) and ECP as explained in clause no. 2.1.1 of section D2.

11.1.2 Interconnecting cables to DCS and required interposing relays (24 V DC) are in Vendor's scope. Interposing relays are to be located in the Switchgear.

11.1.3 Each ECP shall have all the instruments as explained in clause no. 2.1.2 of section D2.

11.1.4 It shall be possible to control every breaker in the test position both from Switchgear as well as remote (DCS) for testing purpose.

11.1.5 **ALL OTHER SERVICES.**

All the motors / Valves and other equipment shall be controlled from respective process control panels/DCS to be supplied by Vendor.

Emergency stop pushbutton shall be provided near all drives except emergency drives and shall be wired directly to MCC. In case of emergency drives, emergency start PB only shall be provided.

11.1.6 The control room shall provide indication & alarms for the 415V auxiliary supply as given below. Any additional indications/alarms considered necessary during detailed engineering also shall be provided. Some of these shall be selected for sequential event recording. For each breaker and bus, grouped alarm for any abnormal conditions shall be provided in the control desk. For all breaker (ACB/MCCB) fed switchgear, status indications shall be available on CRT in form of SLD.

| | | MCC | DCS / PLC | ECP |
|--------------------------|--|-----|-----------|-----|
| STATUS INDICATION | | | | |
| (a) | Incomer & Bus coupler breaker (ACB/MCCB) feeders | | | |
| | ➤ Breaker ON | ✓ | ✓ | ✓ |
| | ➤ Breaker OFF | ✓ | ✓ | ✓ |
| | ➤ Breaker in local | ✓ | ✓ | ✓ |
| | ➤ Breaker in remote | ✓ | ✓ | ✓ |
| | ➤ Breaker in service | ✓ | ✓ | ✓ |
| | ➤ Breaker in test | ✓ | ✓ | ✓ |
| | ➤ DC supply healthy | ✓ | ✓ | ✓ |

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| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan 415V SWITCHGEAR/ DISTRIBUTION BOARDS/MCC | SHEET 14 OF 16 |

| | | MCC | DCS / PLC | ECP |
|-----|--|-----|-----------|-----|
| | ➤ Breaker spring charged | ✓ | ✓ | ✓ |
| | ➤ Trip Relay supervision | ✓ | ✓ | ✓ |
| | | | | |
| (b) | Incomer & Bus coupler breaker (SFU) feeders | | | |
| | ➤ Incomer /Bus coupler ON | ✓ | ✓ | ✓ |
| | | | | |
| (c) | Motor Feeders | | | |
| | ➤ Motor ON | ✓ | ✓ | x |
| | ➤ Motor OFF | ✓ | ✓ | x |
| | ➤ Motor Auto trip. | ✓ | ✓ | x |
| | ➤ Motor Local Emergency PB pressed | x | ✓ | x |
| | ➤ Feeder Fault | x | ✓ | x |
| | ➤ Breaker in Remote | x | ✓ | x |
| | ➤ Breaker in Field | x | ✓ | x |
| | ➤ Breaker in Local | ✓ | ✓ | x |
| | ➤ Breaker in service | ✓ | ✓ | x |
| | ➤ Breaker in test | ✓ | ✓ | x |
| | ➤ Breaker spring charged | ✓ | ✓ | x |
| | ➤ Trip Relay supervision | ✓ | ✓ | x |
| | | | | |
| | ALARM SIGNALS | | | |
| (d) | Incomer & Bus coupler breaker (ACB/MCCB) feeders | | | |
| | ➤ Breaker auto tripped/L/O Relay operated | x | ✓ | ✓ |
| | ➤ Sources paralled beyond pre-set time | x | ✓ | ✓ |
| | ➤ Common outgoing feeder fault | x | ✓ | ✓ |
| | ➤ Incoming 220 V DC control supply failed | x | ✓ | ✓ |
| | | | | |
| (e) | Incomer & Bus coupler breaker (SFU) | | | |

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| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan 415V SWITCHGEAR/ DISTRIBUTION BOARDS/MCC | SHEET 15 OF 16 |

| | | MCC | DCS / PLC | ECP |
|-----|---|-----|-----------|-----|
| | feeders | | | |
| | ➤ Incomer/Bus coupler Fuse blown | ✓ | ✓ | ✓ |
| (f) | BUS/Line PT | | | |
| | ➤ Bus under voltage | ✓ | ✓ | ✓ |
| | ➤ Bus PT fuse failed | ✓ | ✓ | ✓ |
| | ➤ BUS PT not in service | ✓ | ✓ | ✓ |
| (g) | Motor Feeders | | | |
| | ➤ Overload alarm | x | ✓ | x |
| | ➤ Feeder fault / closing permissive not available | x | ✓ | x |
| | ➤ Breaker trip circuit trouble | x | ✓ | x |
| | ➤ Trip through process interlock. | x | ✓ | x |
| | ➤ Local push button pressed | x | ✓ | x |
| | ➤ Breaker spring not charged alarm | x | ✓ | x |

11.1.7 The current, voltage, Power measurements for each bus shall be available both on control room as indicated in this section and elsewhere in the specification. Also for specific motors where the current transducers are indicated, the measurement shall be available at the DCS.

11.1.8 Each remote controlled feeder including spare feeders shall be provided with 2nos interposing relays for start & stop.

11.1.9 The operation, indications and fault alarms for the motors of the auxiliaries shall be displayed as covered in the specification as part of C&I requirements.

12.0 **TESTS**

12.1 Switchgear shall be subjected to all routine tests as per relevant standards along with following tests:

- (a) Mechanical operation test
- (b) Insulation resistance and 500V DC Megger before/ after 1 minute HV test
- (c) Electrical control, interlock and sequential operation tests

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(d) Verification of wiring as per approved schematic.

- 12.2 Temperature rise test on each type and rating of Breaker and associated panels shall be carried out by the Vendor on breaker/Panel to be supplied for this project.
- 12.3 For all other type tests BIDDER shall submit valid type test reports for similar switchgear and ratings of breakers included in the offer. If these tests are not done or test results are not found satisfactory by the PURCHASER then such tests shall be carried out by Vendor without any cost implication.
- 12.4 Routine tests shall be carried out on all associated equipment supplied with switchgear as per relevant standards. Type test certificates of all associated equipment shall be furnished.
- 12.5 Valid type and routine test certificates shall be submitted by the VENDOR before despatch of the switchgear.
- 13.0 For technical particulars refer datasheet-A.

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| SPEC. NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME IV SECTION: D9 |
| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET-A 415V MCC | SHEET 1 OF 6 |

| Sr. No. | Description | unit | Client specification |
|---------|---|---|--|
| 1.0 | Manufacturer's name | | * |
| 2.0 | Make of major components (ACB, Contactor, MCCB , CTs, PTs) | | * |
| 3.0 | Type & model number of panel | | * |
| 4.0 | Applicable standard. | | * |
| 5.0 | Nominal system voltage, phase & frequency | V | 415 V, 3 phase, 50 Hz, 3-wire/ 4- wire |
| 6.0 | System neutral earthing considered | | Effectively earthed |
| 7.0 | Maximum system voltage | V | 456.5 |
| 8.0 | One minute power frequency withstand voltage | Power circuits | KV rms 2.5 |
| | | Control circuits | 1.5 |
| | | Aux. circuits connected to secondary of CTs | 2.0 |
| 9.0 | Short circuit withstand capability a) Short time for 1 sec b) Dynamic rating | KA rms | Min. 50 KA |
| | | KA peak | Min. 127.5KA |
| 10.0 | Reference ambient temperature | Deg. C | 50 |
| 11.0 | Continuous current rating under site reference ambient condition | A | * |
| 12.0 | Maximum temperature of Bus Bars, dropper, connectors & contacts at continuous current rating under site reference ambient temperature | Deg C | 90 deg. C for non silver plated joints |
| | | | 105 deg. C for silver plated |

| | | | | |
|-----------|----------|----------|---------------------------|---|
| REV. NO. | R0 | R1 | JOB NO. TCE - 5750A | CLIENT : RRVUNL |
| PPD. BY : | UM | SK | | |
| CKD. BY : | MSVM | MSVM | | |
| DATE | NOV'2009 | JUN'2012 | | PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan |

| | | |
|----------------------------------|--|--------------------------|
| SPEC. NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME IV SECTION: D9 |
| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET-A 415V MCC | SHEET 2 OF 6 |

| | | | |
|------|--|---------|--|
| | | | joints |
| 13.0 | Material of bus bars considered | | Copper / Aluminum Alloy |
| 14.0 | Cable entry | | Bottom only |
| 15.0 | Degree of protection | | IP- 52 upto 1600A and IP-42 above 1600A. |
| 16.0 | Thickness of sheet steel enclosures / doors. | | |
| | Cold Rolled | | 2mm |
| | Hot rolled | | 2.5mm |
| 17.0 | Shade of paints | | Powder coated paint of shade RAL 7032 (Siemens Grey) |
| 18.0 | Earthing bus bar size & material considered | | 75 x12 mm (min) , GS |
| 19.0 | Clearance in air of live parts | | |
| | a) phase to phase | | 25 mm |
| | b) phase to earth | | 19 mm |
| 20.0 | Circuit breaker | | |
| | a) Type | | * |
| | b) Rated operating duty | | O-3min-CO-3min- CO |
| | c) Rated current at site reference ambient temp. A | | |
| | d) Rated breaking current | KA rms | |
| | e) Rated making current | KA peak | * |
| | f) Short time current withstand capacity for 1 | KA | * |

| | | | | |
|-----------|----------|----------|---|-----------------|
| REV. NO. | R0 | R1 | JOB NO. TCE - 5750A | CLIENT : RRVUNL |
| PPD. BY : | UM | SK | | |
| CKD. BY : | MSVM | MSVM | | |
| DATE | NOV'2009 | JUN'2012 | PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan | |

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| SPEC. NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME IV SECTION: D9 |
| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET-A 415V MCC | SHEET 3 OF 6 |

| | | | |
|------|--|---------|---|
| | sec duration | rms | |
| | g) Asymmetrical breaking current | | * |
| | (1) AC component | | * |
| | (2) DC component | KA rms | as per IEC – 62271 |
| | h) operating time | | * |
| | (1) opening time | | * |
| | (2) closing time | | |
| | i) Closing and opening coil particulars. | Cycle s | 220V DC |
| | j) Switching over voltage factor | Cycle s | 2.2 |
| 21.0 | Trip free operating mechanism type | | Motor charged spring (manual trip & close facility to be provided) |
| 22.0 | Auxiliary control voltage for trip, close, annunciation and spring charging. | | 220 V DC (+/- 15 %) |
| 23.0 | Auxiliary control voltage for space heater, DC failure annunciation, motor winding / space heaters, lighting etc | | 240V AC, 1-Ph, 2 wire, 50 Hz |
| 24.0 | Breakers application | | |
| | a) Incomer s | | Yes |
| 25.0 | Details of contactors/ Switches/Fuses. | | * |
| | • Type | | |
| | • Rated operating duty | | |

| | | | | |
|-----------|----------|----------|---------------------------|---|
| REV. NO. | R0 | R1 | JOB NO. TCE - 5750A | CLIENT : RRVUNL |
| PPD. BY : | UM | SK | | |
| CKD. BY : | MSVM | MSVM | | |
| DATE | NOV'2009 | JUN'2012 | | PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan |

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| SPEC. NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME IV SECTION: D9 |
| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET-A 415V MCC | SHEET 4 OF 6 |

| | | | |
|------|--|--|---|
| | <ul style="list-style-type: none"> • Rated current at site reference ambient temp. • Rated breaking current • Rated making current • Short time current withstand capacity for 1 sec duration • Asymmetrical breaking current <ul style="list-style-type: none"> ○ AC component ○ DC component • Operating time <ul style="list-style-type: none"> ○ opening time ○ closing time | | |
| 26.0 | Details of CTs <ul style="list-style-type: none"> • Type • Ratio • Burden • Accuracy class • Knee point voltage • Magnetizing current at $V_k/2$ • Secondary resistance • Class of insulation • Short time & dynamic current rating • Applicable standard | | (Cast resin, Class E or Better) ** |

| | | | | |
|-----------|----------|----------|---------------------------|--|
| REV. NO. | R0 | R1 | JOB NO. TCE - 5750A | CLIENT : RRVUNL |
| PPD. BY : | UM | SK | | |
| CKD. BY : | MSVM | MSVM | | PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan |
| DATE | NOV'2009 | JUN'2012 | | |

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| SPEC. NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME IV SECTION: D9 |
| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET-A 415V MCC | SHEET 5 OF 6 |

| | | | |
|-------|--|--|--|
| | <ul style="list-style-type: none"> No. of cores | | |
| 27.0 | Details of VTs <ul style="list-style-type: none"> Type Ratio Burden Accuracy class Magnetizing characteristic Method of connection Class of insulation Rated voltage factor (continuous & 8 hours) Applicable standard No. of cores | | (Cast resin Class E or Better , Overvoltage factor 1.5 continious, 1.9 for 08 hours) ** |
| 28.0 | Particular of meters | | * |
| 29.0 | Particular of relays | | * |
| 30.0 | Panels construction details | | * |
| 31.0 | STARTERS | | |
| 31.1. | Type | | DOL/Soft Starters |
| 31.2. | Contactor rated duty as per IS:13947 | | Uninterrupted |
| 31.3. | Utilisation category as per IS:13947 | | AC 3 for non reversible AC 4 for reversible |

| | | | | |
|-----------|----------|----------|---------------------------|--|
| REV. NO. | R0 | R1 | JOB NO. TCE - 5750A | CLIENT : RRVUNL |
| PPD. BY : | UM | SK | | |
| CKD. BY : | MSVM | MSVM | | |
| DATE | NOV'2009 | JUN'2012 | | PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan |

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| SPEC. NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME IV SECTION: D9 |
| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET-A 415V MCC | SHEET 6 OF 6 |

| | | | |
|-------|--|------------|-----|
| 31.4. | Control scheme & bill of material enclosed | YES/ NO | Yes |
| | CONTROL TRANSFORMER : | | |
| | A) Separate for each module | YES/ NO | NO |
| | B) Common for each switchgear section with 100% standby | YES/ NO | YES |
| 31.5. | Single phasing preventer required | YES/ NO | Yes |

NOTE :

- 1.0 '**' Information shall be filled furnished by BIDDER in contract document.
- 2.0 '***' BIDDER shall furnish these details after award of contract.

| | | | | |
|-----------|----------|----------|---------------------------|--|
| REV. NO. | R0 | R1 | JOB NO. TCE - 5750A | CLIENT : RRVUNL |
| PPD. BY : | UM | SK | | |
| CKD. BY : | MSVM | MSVM | | PROJECT : 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan |
| DATE | NOV'2009 | JUN'2012 | | |

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| SPEC.NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME IV SECTION: D9 | | | | |
| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATA SHEET B 415V MCC | SHEET 10 OF 10 | | | | |
| ENQUIRY/SPECIFICATION NO.: | | BIDDER: | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;"></td> <td style="width: 60%;">provided for external connections.</td> <td style="width: 15%;"></td> <td style="width: 10%;"></td> </tr> </table> | | | | provided for external connections. | | |
| | provided for external connections. | | | | | |
| <u>NOTES TO BIDDER</u> | | SIGNATURE OF BIDDER & DATE | | | | |
| 1 ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE . MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS. 2 THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY . SHALL BE ENCLOSED WITH EACH COPY OF THE BID. | | <table border="1" style="margin-left: auto; margin-right: 0;"> <tr> <td style="padding: 5px;">ISSUE R1</td> </tr> </table> | ISSUE R1 | | | |
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| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATASHEET-C 415V MCC | SHEET 1 OF 4 |

DATA TO BE FURNISHED BY THE CONTRACTOR AFTER AWARD OF CONTRACT

1.0 **OVERLOAD RELEASE**

- (a) Characteristics
- (b) Settings

2.0 **SINGLE PHASING PREVENTERS**

- 2.1 Make
- 2.2 Type designation
- 2.3 Rated voltage

3.0 **AUXILIARY RELAYS AND TIMERS**

- 3.1 Time delay range (for timers) Sec.
- 3.2 Resetting features
- 3.3 No. of contacts
 - 3.3.1 Normally open/Normally closed
 - 3.3.2 Contact rating A

4.0 **LIST OF DRAWINGS**

The VENDOR shall furnish the following drawings for each panel and switchgear.

- 4.1 Overall outline dimensions and general arrangement including plan, front elevation, rear & side elevations, clearances required in front and back, details of busduct connections, if any.
- 4.2 Switchgear layout plan including floor openings, fixing arrangements and loading details.
- 4.3 Schematic control diagrams to cover controls, protection, interlocks, instruments, space heaters, etc. for each type of module

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| SPEC. NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME IV SECTION: D9 |
| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATASHEET-C 415V MCC | SHEET 2 OF 4 |

- 4.4 (a) Detailed internal wiring diagram of each type of module, including terminal block numbers, ferrule numbers and the PURCHASER's external cable connection designations
- (b) Itemised bill of material for each module, listing all devices mounted and also otherwise furnished like cable glands, indicating the MANUFACTURER's type, rating, quantity & special notes, if any.
- 4.5 Interpanel interconnection wiring diagram including terminal numbers and ferrule numbers
- 4.6 Switch development diagrams
- 4.7 Block Interlock Diagrams for I/C,B/C & Motor Modules of various types.

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| SPEC. NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME IV SECTION: D9 |
| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATASHEET-C 415V MCC | SHEET 3 OF 4 |

- | | | |
|-----|--|-----------------|
| 5.7 | Each type of protection relay and circuit breaker release characteristics | <u>6 months</u> |
| 5.8 | Fuse characteristic curves for each type and rating of fuse | <u>6 months</u> |
| 5.9 | Space heater ratings and numbers provided per cubicle and the internal distribution scheme for the same, for each switchgear | <u>6 months</u> |

NOTES:

- (a) The VENDOR shall be entirely responsible for the correctness of the internal wiring diagrams mentioned against Item 5.4.
- (b) The VENDOR shall ensure that the characteristics of the CTs, fuses, protection relays, VTs and all other devices offered by him are such as to be suitable for the purpose for which they are intended.
- (c) The VENDOR shall plan his manufacturing schedule so as to allow atleast 4 weeks time for approval of the drawings after their receipt by the PURCHASER.

6.0 TEST CERTIFICATES

- 6.1 Type test certificates of all standard component parts, e.g. contactors, breakers, switches, fuses, relays, CTs, VTs, and for the standard factory built assembly shall be submitted by the VENDOR within 3 months from receipt of order.

7.0 INSTRUCTION MANUALS

The VENDOR shall furnish specified number of copies of the instruction manual which would contain detailed instructions for all operational & maintenance requirement. The manual shall be furnished at the time of despatch of the equipment and shall include the following aspects :

- a) Outline dimension drawings showing relevant cross-sectional views, earthing details and constructional features.
- b) Rated voltages, current, duty-cycle and all other technical information which may be necessary for correct operation of the switchgear.
- c) Catalogue numbers of all components liable to be replaced during the life of the switchgear.

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| SPEC. NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME IV SECTION: D9 |
| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan DATASHEET-C 415V MCC | SHEET 4 OF 4 |

- d) Storage for prolonged duration.
- e) Unpacking.
- f) Handling at site.
- g) Erection.
- h) Precommissioning tests.
- i) Operating procedures.
- j) Maintenance procedures.
- k) Precautions to be taken during operation and maintenance work.

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SECTION D15

**CONTROL PANEL/STARTER
PANEL/JB/PB**

| | | |
|---------------------------------|---|---------------------------|
| SPEC.NO. TCE.5750A-H-500-001 | TATA CONSULTING ENGINEERS LIMITED | VOLUME IV SECTION: D15 |
| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan CONTROL PANELS / STARTER PANEL /JB / PB | SHEET 1 OF 4 |

1.0 **CONTROL PANELS & CABINETS AND MISCELLANEOUS ELECTRICAL EQUIPMENT**

- 1.1. Indoor control panels provided for control of miscellaneous systems in the plant viz., CW System, Coal Handling System, Ash Handling System, RW System, DM Plant, Compressor control, cooling control system, lube oil system, EOT crane and Hoist electrics, trolley lines and power supply arrangement, Electrics for ventilation, air-conditioning, DG AMF Panel, etc. as applicable shall comply with the requirements outlined under clause 1.8 below.
- 1.2. All the meters provided on the panel shall be digital type meters in 96 W x 48H with accuracy class better than 1.
- 1.3. For motor circuits, ammeters shall have a suppressed extended scale to indicate the motor starting current.
- 1.4. The facia annunciation windows if provided on the panel, shall conform to requirements outlined under instrumentation and control section.
- 1.5. All live parts shall be provided with at least phase to phase & phase to earth clearances in air of 25mm & 20mm respectively.
- 1.6. The required 240 V, 1 phase AC supply required for panel illumination and receptacle shall be derived in the control panel itself. However 240V, 1 Phase AC supply for space heating of panel shall be fed from a separate 1-Phase ACDB.
- 1.7. **Technical Requirements**

| SI. NO. | DESCRIPTION | REQUIREMENTS |
|---------|---------------------------------------|---|
| 1.0 | Location | Indoor/Outdoor depending on location |
| 2.0 | Type of mounting | Wall/Floor |
| 3.0 | Cable entry | Top/bottom depending on layout |
| 4.0 | Paint Finish: Outside/Inside | Siemens Grey RAL 7032/ /Glossy white. |
| 5.0 | Supply voltage | 415V, 3 phase, 3 wire/4 wire |
| 6.0 | Control transformer | By Vendor to derive 110V control supply |
| 7.0 | Space heater, lighting supply voltage | 240V, 1 phase AC |
| 8.0 | Degree of protection of | Non-AC rooms-IP 54 class |

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| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan CONTROL PANELS / STARTER PANEL /JB / PB | SHEET 2 OF 4 |

| | | |
|------|---|---|
| | Enclosure for Electrical panels/cabinet enclosure | AC rooms- IP 42 class Outdoor-IP 55 class plus canopy |
| 9.0 | Sheet steel thickness | Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick. |
| 10.0 | Name plate | Black letter engraved on stainless steel plate. Should indicate the tag number and description of the service. |
| 11.0 | Door/Cover | Shall be pad lockable. |
| 12.0 | Safety | All live parts shall be shrouded. No live parts shall be accessible after opening the door/cover. Danger warning plates to be provided. Doors shall be pad lockable and interlocked with Power switch. |
| 13.0 | Earthing | 2 earthing terminals to be provided for connection to the grid. |
| 14.0 | Wiring | Refer specification , Section on panel wiring |

- 2.0 Following miscellaneous equipment shall be included in BIDDER's scope.
- 2.1. Starter Panel for DC Motors
- 2.2. Local push button stations.
- 2.3. Junction boxes (JBs)
- 2.4. Danger boards
- 2.5. Rubber mats
- 3.0 **STARTER PANEL FOR DC MOTORS**
- 3.1. Starter panel when included in motor Bidder's scope shall meet the following requirements.
- 3.2. The constructional features of these panels shall be as per cl.no.1.8 above. Please also refer to Section D.10.
- 4.0 **LOCAL PUSH BUTTON STATIONS (LPB)**
- 4.1. Local push button station shall be provided for all the drive motors of the plant (415V motors & 6.6kV/11kV motors) (start / stop push buttons for unidirectional motors, start/stop/reverse push buttons for bi-directional motors & only start push button for emergency motors) as per scheme requirement.

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| <p>4.2. Start/ Forward/ Open PBs shall have green coloured actuator and Stop/Reverse/Close PBs shall have Red coloured actuator.</p> <p>4.3. The degree of protection of LPBs shall be IP65 with both canopy and lid for outdoor and IP54 with lid and hinged door for indoor applications.</p> <p>4.4. All PBs shall be push to actuate type.</p> <p>4.5. Emergency local stop push button should be lockable in the STOP position. Emergency push buttons shall be stay put type</p> <p>4.6. All push buttons shall be provided with 2 nos. NO and 2 nos. NC contacts for various interlocking purposes. One contact of stop PB shall be directly wired to the switchgear module for direct tripping and another contact to control system.</p> <p>4.7. Terminal block of stud type are to be provided in the LPB station. Terminals to be suitable for 2 cores of 2.5 sq mm conductors with 20% spare terminals.</p> <p>4.8. All LPBs shall be of Poly Carbonate/ FRP/Di-cast aluminium.</p> <p>4.9. Name plate with Tag number and description of the service controlled by the LPB shall be provided on the front.</p> <p>4.10. LPBs shall be suitable for wall/column mounting. Covers shall be provided with captive screws.</p> <p>4.11. The Cable size to be used for LPB connection shall take in to account the voltage drop in the cable between the LPB and the Switchgear/MCC/DCS.</p> <p>5.0 <u>JUNCTION BOXES (JBs)</u></p> <p>5.1. Junction boxes as required for the power plant shall be supplied :</p> <p>5.2. The JBs used in outdoor areas shall be weatherproof type and coated with epoxy paint. enable running a large core cables from (JB/MB) to control panels, terminal cabinets, etc.</p> <p>5.3. All JBs, shall be of polycarbonate /FRP/ Di-cast aluminium.</p> <p>5.4. Danger boards shall be provided in line with the statutory requirements.</p> <p>5.5. Rubber mats shall be provided to meet the safety and other statutory requirements.</p> <p>5.6. Spacing of 250 MM between two rows of Terminal blocks and between the gland plate and the bottom most terminal block to be provided.</p> <p>5.7. Gland plate to be of removable type and made out of 3 mm thick sheet steel.</p> <p>6.0 <u>TESTING</u></p> <p>The following testing shall be conducted on all equipments at works and necessary test certificates shall be furnished.</p> <p>(a) IR (Insulation resistance) test before and after HV test.</p> | | |
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| <p>(b) HV test at 2.5kV for 1 Minute.</p> <p>(c) Electrical Functional test.</p> <p>(d) Mechanical operation of the components.</p> <p>(e) Visual check for compliance as per approved drawings.</p> <p>Note: The international standards such as IEC, which are equivalent to IS, may also be applicable for the above mentioned testing.</p> <p>7.0 <u>DATA TO BE FURNISHED BY THE BIDDER</u></p> <p>7.1 Experience list for the Control panels, JBs offered.</p> <p>7.2 Descriptive literature/pamphlets on the equipment offered.</p> <p>8.0 For technical particulars refer datasheet-A.</p> | | |
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| PART B | RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan LIST OF SUB VENDORS / SUB CONTRACTORS | SHEET 1 OF 10 |

1.0 **LIST OF SUB VENDORS FOR ELECTRICAL EQUIPMENT / SYSTEMS**

BIDDER shall note that no deviation from this list is acceptable after finalisation of this contract.

| Sl. No. | EQUIPMENT | VENDOR |
|---------|----------------------------------|---|
| 1. | POWER TRANSFORMERS (GT, ST, UT) | BHEL, BHOPAL ABB AREVA T & D CROMPTON GREAVES, MUMBAI SIEMENS (APPROVED FOR TRANSFORMERS UPTO 100MVA) |
| 2. | POWER TRANSFORMERS (UAT,SAT,RWT) | BHEL EMCO ABB AREVA T & D CROMPTON GREAVES, MUMBAI BHARAT BIJILEE TELK SIEMENS (VA TECH) |
| 3. | 400kV SWITCHYARD EQUIPMENT | ABB AREVA SIEMENS |
| 4. | SWITCHYARD SHIELD WIRE | RAM SWAROOP ELECTRICALS, BHARAT WIRES AND ROPES. |
| 5. | 400kV SF6 CIRCUIT BREAKERS | BHEL, BHOPAL ABB, BARODA SIEMENS CGL AREVA T&D |

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| Sl. No. | EQUIPMENT | VENDOR |
|---------|-----------------------------------|--|
| 6. | LIGHTNING ARRESTER | ELPRO INTERNATIONAL, PUNE OBLUM ELECTRICALS PVT LTD, HYDERABAD WS INDUSTRIES LTD, CHENNAI CGL AREVA T & D |
| 7. | ISOLATORS | GR POWER SWITCHGEAR, HYDERABAD ABB, BARODA ELPRO INTERNATIONAL HEVELM SWITCHGEAR & STRUCTURES MULLER ELECTROLITE |
| 8. | CTs/CVTs/PTs | BHEL, BHOPAL ABB, BARODA WS INDUSTRIES LTD, BANGALORE TELK CGL AREVA |
| 9. | SWITCHYARD HARDWARE | RASTRA UDYOG, KOKATA KLEMMEN ENGINEERING, CHENNAI AARPEE ASSOCIATES PVB ENTERPRISES |
| 10. | DISC INSULATORS & POST INSULATORS | WS INDUSTRIES LTD, BANGALORE AREVA T & D IEC, BHOPAL BIRLA NGK BHEL, BANGALORE MODERN INSULATORS, ABUROAD |

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| Sl. No. | EQUIPMENT | VENDOR |
|---------|-----------------------------------|--|
| 11. | SWITCHYARD CONDUCTOR & EARTHWIRES | DIAMOND WIRES, BARODA MODERN MALLEABLE, CALCUTTA APAR INDUSTRIES RAM SWAROOP ELECTRICALS BHARAT WIRES & ROPES |
| 12. | GENERATOR CIRCUIT BREAKER (GCB) | SIEMENS ABB AREVA |
| 13. | SCADA | SIEMENS ABB AREVA |
| 14. | PA SYSTEM | PHILIPS ABB SIEMENS |
| 15. | TELECOMMUNICATION EQUIPMENT | ALCATEL PHILIPS SIEMENS HONEYWELL BOSCH TATA TELECOM BPL ABB |
| 16. | PLCC | ABB BHEL |
| 17. | NEUTRAL GROUNDING RESISTORS | S. R. NARKHADE ENGG. PVT. LIMITED, PUNE AMP CONTROL EQUIPMENT PVT. LTD, PUNE BHARATIYA CUTLER HAMMER, MUMBAI RSI SWITCHGEAR |

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| Sl. No. | EQUIPMENT | VENDOR |
|---------|--------------------------------------|--|
| 18. | RELAY PANELS | AREAVA T&D ASEA BROWN BOVERI LIMITED, BARODA SIEMENS LIMITED, NEW DELHI EASUN REYROLLE |
| 19. | SWITCHYARD CONTROL & RELAY PANELS | AREAVA T&D ASEA BROWN BOVERI LIMITED, BARODA SIEMENS LIMITED, NEW DELHI |
| 20. | CONTROL PANELS | SIEMENS ABB AREVA BHEL |
| 21. | HT POWER CABLES | UNIVERSAL CABLES LIMITED, SATNA TORRENT CABLES NICCO CABLES RPG CABLES CCI POLYCAB KEI FGIL INDUSTRIAL CABLES GEMSCAB |

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| Sl. No. | EQUIPMENT | VENDOR |
|---------|------------------------------|--|
| 22. | LT POWER & CONTROL CABLES | FINOLEX CABLES, PUNE POLY CAB INDUSTRIES, BARODA RPG CABLES TORRENT CABLES NICCO CABLES UNIVERSAL CABLES KEI DELTON CCI ISHWAR METAL INDUSTRIES ISHWAR CABLES PVT LTD DAKSHA (only for Control cables) TIRUPATI (only for Control cables) ROMESH CABLES ROLLEX ALPHA COMMUNICATION GEMSCAB |
| 23. | INSTRUMENTATION CABLES | ASSOCIATED CABLES (P) LTD. POLYCAB WIRES PVT LTD. GEMSCAB DELTON CABLES LTD. CORDS CABLES INDS. PVT. LTD SKYTONE ELECTRICALS (INDIA) LTD. NICCO CORP.LTD |
| 24. | 220 V DC LEAD ACID BATTERIES | EXIDE BATTERIES, CALCUTTA HOPPECKE BATTERIES, GERMANY |

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| Sl. No. | EQUIPMENT | VENDOR |
|---------|---|--|
| 25. | 220 V BATTERY CHARGERS | CHABBI ELECTRICAL LIMITED, MUMBAI HBL NIFE POWER SYSTEMS LIMITED, HYDERABAD CALDYNE AUTOMATICS LTD, KOLKATA EMERSON NETWORK POWER(INDIA) PVT,LTD MASSTECH CONTROL PVT. LTD, MUMBAI SABNIFE POWER SYSTEMS LTD, HYDERABAD STATCON UNIVERSAL EXPO FINE, JAIPUR |
| 26. | LIGHTING SYSTEM | PHILLIPS INDIA LTD, MUMBAI CROMPTON GREAVES LTD, MUMBAI BAJAJ ELECTRICALS LTD, MUMBAI WIPRO LTD GE LIGHTING |
| 27. | SEGREGATED/ NON SEGREGATED PHASE BUS DUCT | C&S LTD NEW DELHI SPACEAGE POWER GEAR GE BHEL |
| 28. | LV SWITCHGEAR –PMCCs, MCCs, PROCESS DBs | L&T LTD, MUMBAI SIEMENS LTD., MUMBAI CONTROL SWITCHGEAR CO., NEW DELHI SCHNEIDER AREVA |

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| Sl. No. | EQUIPMENT | VENDOR |
|---------|---|---|
| 29. | LV SWITCHGEAR- Non draw out DBs such as Space heater DBs, Lighting DBs, AC & DC distribution boards (TVDB & BVDB excluded), Workshop MCC, Admin building PCC, Welding DBs, Receptacle DBs) | L&T LTD, MUMBAI SIEMENS LTD., MUMBAI CONTROL SWITCHGEAR CO., NEW DELHI SCHNEIDER GE POWER SPACE AGE |
| 30. | MV SWITCHGEAR (11kV & 6.6kV) | ABB, NASIK SIEMENS LTD., MUMBAI BHEL AREAVA, T&D |
| 31. | ELECTRIC MOTORS (HT & LT) | BHEL CGL KEC ABB SIEMENS AREVA (MARATHON) |
| 32. | CABLE END TERMINATION KITS | RAYCHEM LTD, MUMBAI |
| 33. | CABLE GLANDS | COMET DOWELS |
| 34. | ELECTRIC ACTUATORS | AUMA LTD., BANGALORE ROTORK LTD., MUMBAI LIMITORQUE LTD., FARIDABAD |
| 35. | LV/MV CTS /PTS | PRAGATHI INDUSTRIES, KOLKATTA JYOTHI LTD., BARODA GILBERT & MAXELL, BARODA PRECISE ELECTRICALS PRAYOG ELECTRIC BOMBAY |

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| Sl. No. | EQUIPMENT | VENDOR |
|---------|---|---|
| 36. | RELAYS FOR SWITCHGEARS | SIEMENS LTD ABB LTD AREAVA T&D |
| 37. | NEUTRAL GROUNDING TRANSFORMERS | VOLTAMP LTD, BARODA INDCOIL LTD. PRAYOG ELECTRIC BOMBAY |
| 38. | UPS | EMERSON DB POWER ELECTRONICS LTD HI-REL ELECTRONICS LTD KELTRON NUMERIC |
| 39. | ELECTRICAL WORKS OF CONSTRUCTION POWER SUPPLY | ISHWAR METAL INDUSTRIES, JAIPUR VEDANSII IB ELECTRICALS, CHITIARGARH |
| 40. | AVR | BHEL LTD ABB LTD SIEMENS LTD |
| 41. | IPBD & LAVT | REEP INDUSTRIES PVT LTD POWERGEAR INDIA LTD CONTROL AND SWITCHGEAR LTD BHARAT HEAVY ELECTRICALS LTD |
| 42. | DC STARTERS | AMTECH ELECTRONICS LARSEN & TOUBRO |
| 43. | ELEVATOR | OTIS ELEVATORS CO.(INDIA) LTD SCHINDLER INDIA PVT.LTD KONE ELEVATOR INDIA LTD JOHNSON LIFTS LTD MITSUBISHI THYSEEN KRUPP ELEVATOR OF INDIA |

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| Sl. No. | EQUIPMENT | VENDOR |
|---------|------------------------------|--|
| 44. | VFD | TOSHIBA INDIA SIEMENS LIMITED LARSEN AND TOUBRO LTD ALLAN BRADLEY ABB LTD HI-REL ELECTRONICS LTD DANFOSS INDUSTRIES LTD HITACHI |
| 45. | CABLE TRAY | SHRENIK AND COMPANY PREMIER POWER PRODUCTS RELIANCE CABLE TRAY PATNI CABLE TRAY SADHNA CABLE TRAYS SHRUTI INDUSTRIES STEELITE ENGINEERS LTD INDIANA ENGINEERING LTD SAMISTHY PROFAB |
| 46. | ELECTRICAL INSTALLATION WORK | CROMPTON GREAVES LTD SIEMENS LTD LARSEN AND TOUBRO LTD AREVA |

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| Sl. No. | EQUIPMENT | VENDOR |
|---------|--------------------------------------|--|
| 47. | SERVICE TRANSFORMERS | EMCO TRANSFORMERS LTD., MUMBAI BHARAT BIJLEE LIMITED, MUMBAI KIRLOSKAR ELECTRICALS LIMITD, BANGALORE VOLTAMP, BARODA CROMPTON GREAVES LIMITED, MUMBAI VIJAY ELECTRICAL HYDRABAD. UTTAM BHARAT JAIPUR. ABB AREVA |
| 48. | LT ELECTRIC MOTORS (WORKSHOP) | SIEMENS CGL KIRLOSKAR |
| 49. | ELECTRICAL LABORATORY INSTRUMENTS | APURV TECHNOLOGY PRODUCT SCOPE TINSLEY |
| 50. | ALTERNATOR FOR DG SET | JYOTHI LTD, BARODA KIRLOSKAR ELECTRIC LTD, BANGALORE STAMFORD |

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SECTION - 3

PROJECT DETAILS GENERAL TECHNICAL REQUIREMENTS

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other respective sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

| | | |
|------------------------|--|--|
| a) | Customer/ Purchaser/ Owner | Rajasthan Rajya Vidyut Utpadan Nigam Ltd. , Jaipur |
| b) | Consultant | Tata consulting Engineer Ltd. , Bangalore |
| c) | Project Title | 2X660MW Super –Critical Thermal Power Station, Stage –V, Unit 7 & 8-400kV Switchyard at Suratgarh |
| d) | Location | Prabat Nagar , Suratgarh Sriganganagar district, Rajasthan |
| e) | Altitude and longitude | Lattitude:29 deg. 10 min. N Longitude: 74 deg. 01 min. E |
| f) | Elevation above mean sea level | 186 m(approximately) |
| g) | Transport Facilities | Suratgarh project is located 27 km from Suratgarh , 15 km from Suratgarh to Biradhwal on NH15, 12km in east from NH15. |
| h) | Postal Address | To follow |
| SITE CONDITIONS | | |
| a) | Mean of daily maximum temperature | 32.3 deg. C |
| b) | Mean of daily minimum temperature | 19.6 deg. C |
| c) | Highest temperature recorded | 50 deg. C |
| d) | Lowest temperature recorded | -2.8 deg. C |
| e) | Design ambient temperature for electrical equipment design | 50 deg. C |
| f) | Relative humidity | Varies between 21 % and 81% |
| g) | Pollution Severity | Heavily Polluted |
| h) | Seismic zone | II |
| i) | Basic Wind speed | 47 m/sec |
| j) | Annual mean wind speed | 4km/hr |
| k) | Terrain category | 2 |
| l) | Annual average rain fall | 312 mm |



SYSTEM PARAMETERS

| | | |
|-------------------------------------|---------------------|---------------------|
| Nominal system voltage | 400 kV | 11kV |
| Highest system voltage | 420 kV | 12kV |
| Basic Impulse level(dry /wet) | 1425kVP | 75kVP |
| Power frequency withstand voltage | 630kVrms | 28kVrms |
| Switching Impulse withstand voltage | 1050 kVP | NA |
| Rated short time current | 50 kA for 3 sec | 40 kA for 1 sec |
| Frequency | 50 Hz | 50 Hz |
| Creepage distance | 31mm/kV | 31mm/kV |
| System Earthing | Effectively Earthed | Effectively Earthed |

AUXILIARY POWER SUPPLY

| | |
|--------------------------|--|
| 3 phase A.C power supply | 415V \pm 10%, 50 Hz, 3-phase 4 wire, solidly earthed with variation in frequency of \pm 5% |
| 1 phase A.C power supply | 240V \pm 10%, 50 Hz, 1-phase , 2 wire , AC supply with variation in frequency of \pm 5% |
| D.C. power supply | 220V \pm 15%, 2-wire ungrounded 48V \pm 10%, 2 wire system positively earthed |

Combined variation of voltage and frequency shall be +/- 10%

3.2 GENERAL TECHNICAL REQUIREMENT

3.2.1 TYPE TESTS

All equipment/systems to be supplied shall conform to type tests as per relevant standards and proven type. The Bidder / Contractor shall furnish the reports of all the type tests carried out within last **five years from the date of opening of the tender** (i.e. 03.12.2012) as listed in relevant clauses in respective electrical specification and relevant standards for all components / equipment / systems. These reports should be for the tests conducted on identical/ similar components /equipment/systems to those offered / proposed to be supplied under this contract.

Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off.

In case Contractor is not able to submit report of type test(s) conducted in last five years, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer/Purchaser, and reports shall be submitted for approval. No charges shall be paid under this contract. All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

3.2.3 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.



3.3 MATERIAL/WORKMANSHIP

3.3.1 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case, he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

1.0 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipments located



in non-air conditioned areas shall also be of same type.

3.4 COLOUR SCHEME AND CODES FOR PIPE SERVICE/PANELS

The contractor shall propose a color scheme for those equipment/items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include:

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finish colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All the steel works shall be thoroughly cleaned of rust, scale, oil, grease, dirt and scarf by pickling, emulsion cleaning, etc. The sheet steel shall be phosphate /oven dried and then painted with two coats of zinc rich primer paints. After application of the primer, two coats of finished synthetic enamel paint shall be applied. The colour of the finished coats inside shall be **glossy white** and exterior of the treated sheet steel shall be **shade 631 of IS 5 /RAL 7032** for all switchboard /MCC/distribution board, control panels etc.

Sufficient quantities of touch paint shall be furnished for application at site. All the indoor cubicles shall be the same as exterior surface and for other miscellaneous items, colour scheme will be approved by the purchaser.

3.5 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.6 FUNGI-STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

3.7 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished



or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

3.8 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be **610 gm/sq.m** and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM. Average weight of zinc coating shall be **750gm/sq.m**.

3.9 PACKING

The following details are to be clearly indicated in the material forwarding documents:

- a) Name and address of the consignee.
- b) Purchase order number.
- c) Name of supplier/s.
- d) Description of equipment / material.
- e) Net weight.
- f) Gross weight.

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc.

3.10 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.



The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.11 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc to be installed shall be provided with degree of protection as detailed here under:

- a) Installed outdoor: IP-55
- b) Installed indoor in air conditioned area: IP-42
- c) Installed in covered area IP: 52
- d) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS: 13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.12 RATING PLATES, NAME PLATES AND LABELS

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirements.

All such nameplate instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternately two separate plates one with Hindi and other with English inscriptions may be provided.

3.13 EARTHING

Circuit breakers, LA, Isolator, CVT, CT, BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.14 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of sheet steel. Sheet steel used shall be at least 2.0 mm thick cold rolled 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. Cabinet/boxes shall be free standing floor mounting type,



wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/ cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled **Neoprene gaskets**. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project atleast 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required

3.15 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heater shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heater to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centered in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of a resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and air. Alternatively, they shall consist of resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze the surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

3.17 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.

3.18 DOCUMENTATION

3.18.1 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.



The supplier shall necessarily submit all the drawings / documents unless any thing is waived.

All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.18.2 DRAWINGS

All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearances and spaces required for installation and interconnection between various portions of equipments and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, name of consultant, the unit designation, RRVUNL contract no. and the name of the Project .If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer if so required.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.18.3 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalised at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

| | | |
|------|---|---|
| i. | Approval/comments/by employer on Initial submission | Within 3 weeks of receipt |
| ii. | Resubmission | Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time. |
| iii. | Approval or comments | Within 2 weeks of receipt of resubmission |
| iv. | Furnishing of distribution copies | 2 weeks from the date of last approval. |

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.



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Contractor – Bharat Heavy Electricals Ltd.

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The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer enclosed sheet for details of Title block.

3.18.4 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

- 1) Drawings
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) Manufacturing Quality Plan

3.18.5 DOCUMENTATION SCHEDULE

| S. No | DESCRIPTION | TENDER STAGE | CONTRACT STAGE FOR APPROVAL | FINAL DOCUMENTATION | |
|-------|-----------------------------------|--------------|-----------------------------|---------------------|-----|
| | | | | Prints | CDs |
| 1 | Drawings and Data Sheets | 1 | 7 | 8 | - |
| 2 | Drawings "As Built " | - | - | 8 | 05 |
| 3 | Type Test Reports | 1 | 3 | 4 | - |
| 4 | Erection Manuals | - | 7 | 8 | - |
| 5 | Operation and Maintenance Manuals | - | 7 | 8 | - |
| 6 | Manufacturing Quality Plan | 1 | 7 | 8 | - |
| 7 | Field Quality Plan | 1 | 7 | 8 | - |
| 8 | Inspection Test Reports | - | - | 8 | - |

Soft copies of drawings at contract stage shall also be submitted in **PDF format**.

Drawings will also be submitted in CD in AUTOCAD package for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.



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SECTION - 4

LIST OF DOCUMENTS

MASTER DOCUMENT SCHEDULE – TO BE SUBMITTED DURING DETAILED ENGG.

| S N | DRAWING/ DATA SHEET DESCRIPTION | DRAWING/ DATA SHEET NO. | SUBMISSION DATE | BHEL ACCEPTED SUBMISSION DATE |
|----------|---|----------------------------|--------------------|----------------------------------|
| A | TECHNICAL DATA SHEET | | | |
| 1 | D.S. For Packaged AC unit | TB-DS-360-553-01 | | |
| 2 | D.S. For Split AC units | TB-DS-360-553-02 | | |
| 3 | D.S. For GI Sheet for Ducts | TB-DS-360-553-03 | | |
| 4 | D.S. For Insulation | TB-DS-360-553-04 | | |
| 5 | D.S. For Supply & Return Air Diffuser | TB-DS-360-553-05 | | |
| 6 | D.S. For Fire Damper | TB-DS-360-553-06 | | |
| 7 | D.S. For Pre-filter & Fine filter | TB-DS-360-553-07 | | |
| 8 | D.S. For Pan Humidifier | TB-DS-360-553-08 | | |
| 9 | D.S. For Strip Heater | TB-DS-360-553-09 | | |
| 10 | D.S. For Instruments | TB-DS-360-553-10 | | |
| 11 | D.S. For Condensing water pumps | TB-DS-360-553-11 | | |
| 12 | D.S. For Piping & Valves | TB-DS-360-553-12 | | |
| 13 | D.S. & GA For Cooling Tower | TB-DS-360-553-13 | | |
| 14 | D.S. For Supply Air Fans | TB-DS-360-553-14 | | |
| 15 | D.S. For Exhaust Fans | TB-DS-360-553-15 | | |
| 16 | Ventilation Fans Calculation | TB-CL-360-553-16 | | |
| 17 | BOQ - HVAC System | TB-BQ-360-553-17 | | |
| 18 | PG Test Procedure | TB-PG-360-553-18 | | |
| B | DRAWINGS | | | |
| 1 | P & I Diagram for AC system | TB-DG-360-553-001 | | |
| 2 | A C Ducting layout for Control building | TB-DG-360-553-002 | | |
| 3 | AHU room layout (Ground Floor) | TB-DG-360-553-003 | | |
| 4 | Outdoor Cooling tower layout | TB-DG-360-553-004 | | |
| 5 | Ventilation fan layout for Control building | TB-DG-360-553-005 | | |
| 6 | Schematic, GA & SLD for HVAC MCC panel | TB-DG-360-553-006 | | |
| 7 | Schematic, GA & SLD for AC Annunciation panel | TB-DG-360-553-007 | | |
| C | OTHER DOCUMENTS | | | |
| 1 | Cable Schedule (with cable lengths) | TB-DOC-360-553-20 | | |
| 2 | Electrical Load List | TB-DOC-360-553-21 | | |



SECTION- 5

ENCLOSURES TO SPECIFICATION

SCHEDULES TO BE FILLED UP BY THE BIDDER

- Schedule 1 **Schedule of makes of Equipments**
- Schedule 2 **Schedule of Deviations**
- Schedule 3 **Schedule of past experience and qualifying requirements**
- Schedule 4 **Schedule of performance certificates**
- Schedule 5 **Schedule of type test and special tests**
- Schedule 6 **Details of contact persons (technical & commercial)**
- Schedule 7 **Enclosures to Specification**
 - a. **ANNEXURE-A** **Drawings**
 - b. **ANNEXURE-B** **List of Approved Makes**



SCHEDULE-1

MAKES OF IMPORTANT ITEMS / COMPONENTS OF EQUIPMENTS AND THEIR DETAILS

| ITEM NAME | NAME OF MANUFACTURER | PLACE OF MANUFACTURE OF ITEM | PLACE OF TESTING AND INSPECTION | COMPLIANCE WITH ISO 9001 (YES/NO) |
|-----------|----------------------|------------------------------|---------------------------------|-----------------------------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Place

Signature of the authorized representative of Bidder

Name -----

Date

Designation-----

Company seal-----



SCHEDULE-2

SCHEDULE OF TECHNICAL DEVIATION

The following are the deviations / variations / exceptions from the specification:

| Section | Clause No./ Page No. | Statement of deviation/ Variations/Exceptions |
|---------|-------------------------|--|
|---------|-------------------------|--|

- 1) In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract is deemed to be in compliance with the specification.
- 2) If there is NIL deviation, even then the format to be filled as **NIL DEVIATION**
- 3) Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

Place _____ Signature of the authorized representative of Bidder
Name -----
Date _____ Designation-----
Company seal-----



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SCHEDULE – 3

SCHEDULE OF PAST EXPERIENCE AND QUALIFYING REQUIREMENT

Following is the list of earlier orders executed by us for supply of equipment / material of Similar nature over the last past five years:

| S.No. | Item | Brief rating | Qty | customer | Date of order | Date of supply | Order value |
|-------|------|--------------|-----|----------|---------------|----------------|-------------|
|-------|------|--------------|-----|----------|---------------|----------------|-------------|

Place

Signature of the authorized representative of Bidder

Date

Name-----

Designation-----

Company seal -----

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.



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SCHEDULE – 4

SCHEDULE OF PERFORMANCE CERTIFICATE

Bidder shall furnish the performance certificate of the similar equipment having
The following details:

| S.No. | Item | Brief rating | Qty | Customer | Date of supply |
|-------|------|--------------|-----|----------|-------------------|
|-------|------|--------------|-----|----------|-------------------|

Place _____ Signature of the authorized representative of Bidder

Date _____ Name-----

Designation-----

Company seal -----

Note: Continuation sheets of like size and format may be used as per the Bidder's
Requirement and shall be annexed to this schedule.



SCHEDULE- 5

SCHEDULE OF TYPE TESTS AND SPECIAL TESTS

The following type tests and special tests as called for in the Specification shall be conducted (all type tests / special tests as mentioned in the relevant clauses of the Specification shall be listed here):

| Sl no. | Clause no/ page no of Specification | Details of test | Lab in which to be conducted | Whether test to be conducted free or on chargeable basis. Mention 'FREE' or 'CHARGEABLE' | If charges per test have been quoted for in the price bid. YES / NO |
|--------|-------------------------------------|--|------------------------------|--|---|
| | | A. Type Tests | | | |
| | | 1. | | | |
| | | 2. | | | |
| | | B. Routine Tests | | | DO NOT |
| | | 1. | | | MENTION |
| | | 2. | | | ANY PRICE |
| | | C. Site Tests | | | IN THIS |
| | | 1. | | | COLUMN |
| | | 2. | | | |
| | | D. Special Tests (specified) | | | |
| | | 1. | | | |
| | | 2. | | | |
| | | E. Other tests at works / site recommended by the Bidder | | | |
| | | 1. | | | |
| | | 2. | | | |

NOTE:

- 1) Details have to be furnished on cables as well as accessories, each separately.
- 2) **NO PRICE SHALL BE FURNISHED IN THIS FORMAT.**

Place

Signature of the authorized representative of Bidder

Name-----

Date

Designation-----

Company seal-----



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SCHEDULE-6

DETAILS OF CONTACT PERSON BOTH TECHNICAL AND COMMERCIAL

Name

Address for correspondence

Phone No.

Fax No.

Email

Place

Signature of the authorized representative of Bidder

Date

Name-----

Designation-----

Company seal -----

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.



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SCHEDULE – 7

ENCLOSURES TO SPECIFICATION

(ANNEXURE-A)

DRAWINGS

1. CONTROL ROOM BUILDING OF SURATGARH 400 KV SUB/STN. CONCEPTUAL PLAN LAYOUT

DRG. NO. TB-3-360-316-026 & TB-0-333-316-009



(ANNEXURE B)

LIST OF MAKES

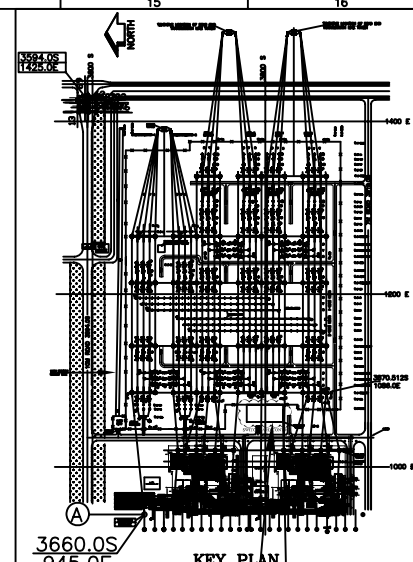
Bidder shall choose make of materials from list below. **However final approval for the makes will be given by the customer during the detailed engineering stage** inline with Cl. No. 3.1.2 h), Sec-1.

A. AIR CONDITIONING & VENTILATION SYSTEM MAKES

| S.N. | Description | Makes |
|------|---|---|
| 1. | Package AC | Voltas / Blue Star / Carrier |
| 2. | Split Air Conditioner | Voltas / Blue Star / Carrier / Hitachi |
| 3. | Air Handling Units | Voltas / Blue Star / Carrier-Aircon / Zeco / Carryaire(Flakt) / Ethos / Saiver Suvidha / Edge Tech |
| 4. | AHU Fan (Centrifugal Fan) | CB.Doctor / Flakt / Nicotra / Comefri / Krugger /Humidin |
| 5. | Cooling Coil for AHU | Voltas / Blue Star / Carrier-Aircon / Jaypee / Zeco / Carryaire(Flakt) / Ethos / Saiver Suvidha / Edge Tech |
| 6. | Induction Motors (LT) | Siemens / ABB / Kirloskar / CGL/KEC/Marathon |
| 7. | Cooling Tower | Paharpur / Mihir |
| 8. | Air Filters | John Fowler /Spectrum |
| 9. | Axial Fans/F.A. Fans | Marathon / Flakt / C Doctor / Humidin/ Krugger |
| 10. | Insulation Material | Lloyds UP Twiga |
| 11. | Balancing Valve | Advance |
| 12. | Butterfly Valve | Audco / Fouress / Inter Valve / Keystone / BDK |
| 13. | Non Return Valves | Fluid line//Hi-tech Valves/ Cresent/Leader/AV Valves /H.Sarkar |
| 14. | Gate/Globe Valves | Cresent/Leader/AV Valves/Kirloskar/ Fouress /H.Sarkar |
| 15. | Gate/Globe Valves (forged Steel/Cast Steel) | Cresent/Leader/AV Valves/BDK/Audco |
| 16. | Relief/Purge Valve | Brassomatic |
| 17. | Piping | Tata / Jindal / SAIL/BST. |
| 18. | GI Sheets for Ducting | SAIL / Jindal/Bhushan / TATA. |
| 19. | Thermostats | Honeywell / RANCO / Penn / Danfoss / Indfoss |
| 20. | Humidistat | Honeywell / Penn. |
| 21. | Antifreeze thermostat | RANCO / Honeywell / Penn / Danfoss / Indfoss |
| 22. | Strip Heaters | Escorts / RACOLD / Daspas/ALCO/HEATCO/Hotset |
| 23. | Pressure Gauges | A.N.INST/ GENERAL INST CONSORTIUM/ GLUCK/H.GURU IND/H.GURU INST/ WAAREE INSTRUMENTS |
| 24. | Temperature Gauges | A.N.INST/ INSTWAAREE INSTRUMENTS |
| 25. | Level Gauge | Levcon / General Instruments/ Chemtrols /SBEM, Pune/V, Automat Mumbai |



| | | |
|-----|--|--|
| 26. | Pressure Switches | Switzer / Indfoss |
| 27. | DP Switches | SWITZER |
| 28. | Temperature Switch | SWITZER |
| 29. | Flow Element | MICROPRECISION /STAR-MECH |
| 30. | Temperature Element | GENERAL INST CONSORTIUM/ PYRO ELECTRIC WAAREE INST |
| 31. | Transmitters | FISHER-ROSEMOUNT/SIEMENS/TATA HONEYWELL |
| 32. | Sight Flow Indicators | BLISS ANAND/ CHEMTROLS |
| 33. | Rotameter | CHEMTROLS SAMIL/EUREKA IND |
| 34. | Level Switch | BLISS ANAND / CHEMTROLS / Levcon / V. AUTOMATE |
| 35. | Pan Humidifier | Rapid Cool / Hotset/ALCO |
| 36. | Fire Damper | TSC /Carryaire/ Ravistar. |
| 37. | 3-Way Mixing Valve with actuating motor | Siemens Building Technology / Honeywell / Johnson |
| 38. | Y-Strainers | Multitex / Greaves Cotton / Grand Prix / Jaypee / SANT |
| 39. | Flow Meter | INSTRUMENTATION ENGINEERS PVT LTD. / EUREKA |
| 40. | Control Panel | Industrial Control & Appliance / Control & Switchgear / Pyrotech / Positronics /Rittal |
| 41. | LV Switchgear –PMCCs, MCCs, Process DBs | L&T LTD, MUMBAI SIEMENS LTD., MUMBAI CONTROL SWITCHGEAR CO., NEW DELHI SCHNEIDER AREVA |
| 42. | Annunciator for Panels | Procon/ Pyrotech |
| 43. | Pot Strainer | Multitex / Greaves Cotton / Otoklin / Grand Prix / Jaypee / SANT. |
| 44. | Temp/RH Sensor | Siemens Building Technology/Johnson/ Honeywell |
| 45. | Motorized Butterfly Valve with single phase actuator | Siemens Building Technology/Johnson/Honeywell |
| 46. | Water Softening Plant | Thermax, Ion Exchange , Dosi Ion |
| 47. | Axial Flows Fans | Marathon / Flakt / CB Doctor/ Hyderabad Pollution/ SK System / Advance Ventilation / Patel Air Flow / Kruger / Nicotra |
| 48. | Electrical Motors (HT & LT) | BHEL CGL KEC ABB SIEMENS AREVA (MARATHON) |



NOTES:-

1. ALL DIMENSION ARE IN mm EXCEPT ELEVATION OF BUILDING AND OVERALL ROOM DIMENSION ARE IN METER.
2. SEPARATE DRAWING SHALL BE SUBMITTED FOR DETAILED ARCHITECTURE AND TRENCH LAYOUT OF CONTROL ROOM BUILDING.
3. CONTROL ROOM, RELAY ROOM, PLCC ROOM AND CONFERENCE ROOM SHALL PACKAGE AIRCONDITIONED.
4. STORE, PANTRY AND TOILET SHALL BE PROVIDED WITH EXHAUST FAN. BATTERY ROOM SHALL BE PROVIDED WITH EXHAUST FAN AND LOVERS FOR FRESH AIR.
5. ELECTRONICS TEST LAB, LIBRARY CUM RECORD ROOM, SHIFT INCHARGE ROOM, MAINTENANCE STAFF ROOM, MAINTENANCE ROOM & ENGINEERS ROOM SHALL BE PROVIDED WITH SPLIT AC OF ADEQUATE CAPACITY.
6. LT SWITCH GEAR ROOM & CABLE VAULT SHALL BE PROVIDED WITH SUPPLY AIR FAN FOR POSITIVE PRESSURE VENTILATION. AHU ROOM SHALL BE PROVIDED WITH FRESH AIR FAN.
7. THE DIMENSION AND ARRANGEMENT OF PANELS INSIDE ROOM ARE INDICATIVE AND SHALL BE FINALISED DURING DETAILED ENGINEERING.
8. ALL ROOM EXCEPT AHU ROOM SHALL BE PROVIDED WITH WINDOW.
9. --- DENOTE FUTURE PANEL
10. ALL THE DIMENSIONS OF THE ROOMS ARE FROM CENTER LINE OF WALL (THICKNES OF WALL 230MM)
11. ALUMINIUM GLAZED WINDOW SHALL BE PROVIDED IN THE FIRST FLOOR (AROUND THE CONTROL ROOM, RELAY ROOM & PLCC ROOM) TO HAVE A CLEAR VIEW OF SWITCHYARD EQUIPMENT
12. ** =DETAILED ARRANGEMENT OF MONORAIL, PLATFORM, REMOVABLE HANDRAIL AND ELECTRICAL HOIST FOR LIFTING OF PANEL AT FIRST FLOOR SHALL BE SHOWN IN CIVIL DRAWING. RATING OF MONORAIL FOR EQUIPMENT LIFTING IS 1.5 TON.
13. NON SEGREGATED PHASE BUS DUCT BETWEEN DRY TYPE TRANSFORMER & 415V ACDB SHALL BE SUITABLE FOR TOP ENTRIES. THE DETAILED OF BUS DUCT CONNECTION SHALL BE SHOWN IN SEPARATE DRAWING.
14. CONTROL ROOM TOWARDS CABLE VAULT SHALL BE SUITABLE EXTENDIBLE TO ACCOMMODATE CONTROL & RELAY PANEL FOR FOUR FUTURE BAYS.
15. CONTROL ROOM, RELAY ROOM, LT SWITCH GEAR ROOM, BATTERY ROOM & PLCC ROOM SHALL BE PROVIDED WITH FIRE PROOF DOOR. THE FIRE PROOF DOOR SHALL BE RATED FOR A MINIMUM OF TWO HOURS.
16. WASH BASIN SHALL BE PROVIDED IN BATTERY ROOM
17. IN AIR LOCK LOBBY ENTRY ALUMINIUM GALZED AUTOMATIC CENTER OPENING SLIDING DOOR SHALL BE PROVIDED . DETAILS SHALL BE SHOWN IN CIVIL DRAWING. AUTOMATIC DOOR POWER SUPPLY SHALL BE FED FROM EMERGENCY AC SECTION OF LT SWITCHGEAR.
18. STAIR CASE SHALL BE COVERED. LOWER HEIGHT DOOR SHALL BE PROVIDED FOR BOTH EXTERNAL STAIR CASE.
19. BATTERY SHALL BE LEAD ACID PLANTE TYPE. BATTERY ROOM FLOOR SHALL BE PROVIDED WITH ACID PROOF TILES. UP TO HEIGHT 2.3M FROM FFL.
20. HEAT LOAD PER PANEL IS APPROX. 100W. WEIGHT PER PANEL IS APPROX. 300Kg
21. NLP, ELP, DLP, ACAN AND FIRE ALARM PANEL SHALL BE WALL MOUNTED.
22. PORTABLE PUMP AND MOTOR SHALL BE PROVIDED IN AHU ROOM FOR LIFTING THE WATER FROM 400MMX400MM SUMP.
23. COLUMN LOCATION ARE INDICATIVE AND DETAILED SHALL BE SHOWN IN CIVIL DRAWING.
24. BRICK WALL SHALL BE PROVIDED TOWARDS SOUTH OF CONDENSER WATER CIRCUIT.

LEGEND:-

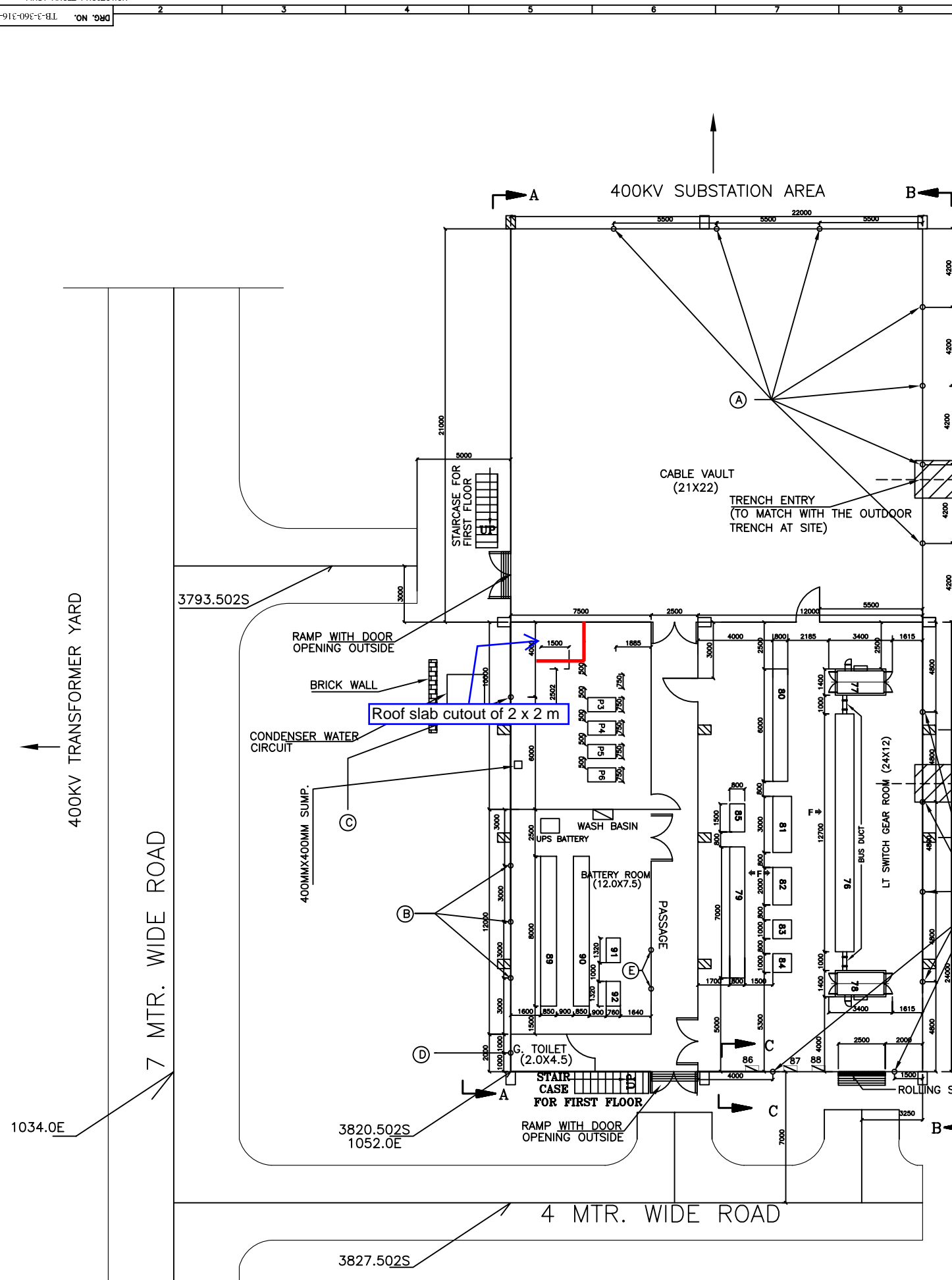
- MLDB= MAIN LIGHTING DISTRIBUTION BOARD
- WDB= WELDING DISTRIBUTION BOARD
- ELDB= EMERGENCY LIGHTING DISTRIBUTION BOARD
- LT= LIGHTING TRANSFORMER
- DCDB= DC DISTRIBUTION BOARD
- AHU= AIR HANDLING UNIT
- PLCC= POWER LINE CARRIER COMMUNICATION
- P1 TO P6= PACKAGE UNITS
- PH= PAN HUMIDIFIER
- PDB= POWER DISTRIBUTION BOARD
- MT= 11/0.433kV, 630kVA DRY TRANSFORMER
- FFL= FINISHED FLOOR LEVEL
- FGL= FINISHED GROUND LEVEL
- F = FRDNT
- CH = CHARGER
- NLP = NORMAL AC LIGHTING PANEL
- ELP = EMERGENCY AC LIGHTING PANEL
- DLP = DC LIGHTING PANEL
- EPABX = ELECTRONIC PRIVATE AUTOMATIC BRANCH EXCHANGE
- = BUS DUCT
- FA = FIRE ALARM PANEL
- ACAN= AIR CONDITIONING ANNUNCIATION PANEL
- = AUTOMATIC (CENTER OPENING) DOUBLE SLIDING DOOR ALUMINIUM GLAZE

REFERENCE DWG. :-

LAYOUT PLAN FOR 400KV S/S AT SURATGARH
DWG. NO. TB-0-360-316-002

SWITCHYARD CONTROL ROOM

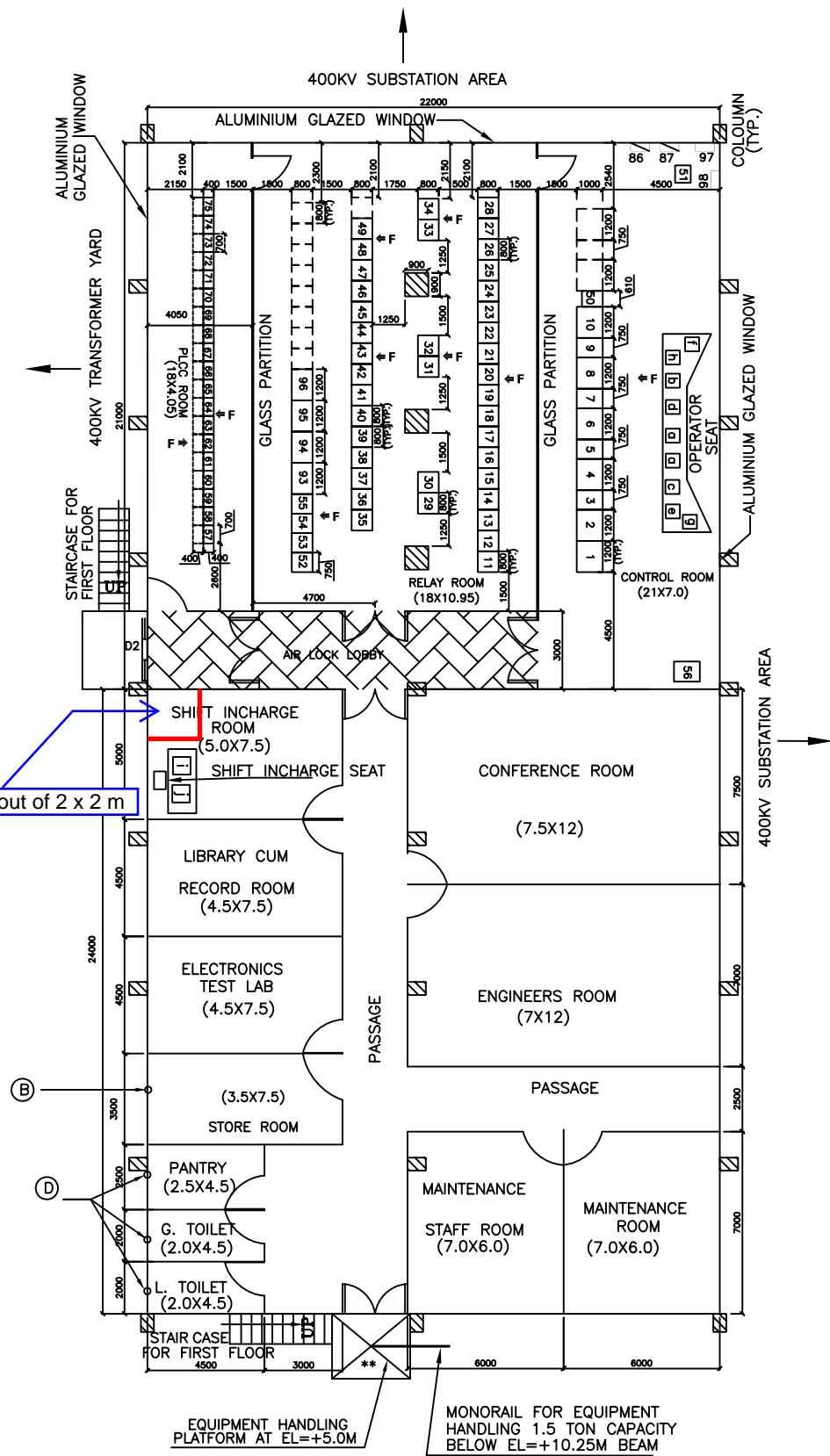
GROUND FLOOR PLAN AT E.L.=+0.5M



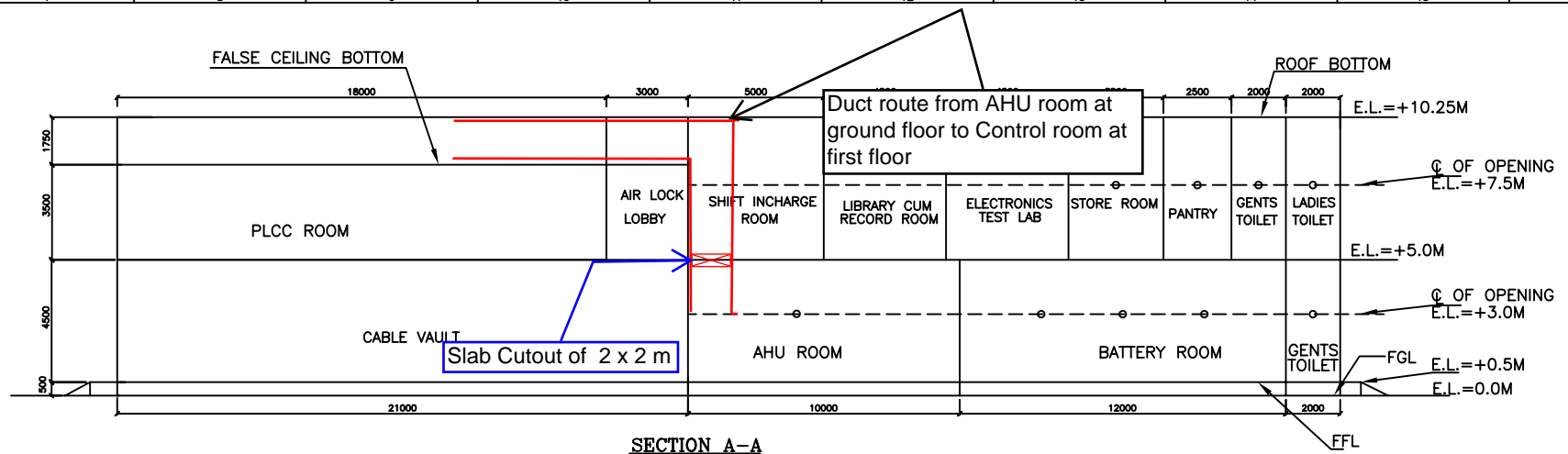
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|--|-----------|-----------------------------------|----------|-------------|-------------------------|-------------|
| 03 | 05-08-14 | AS PER TCE LETTER DATED- 11-07-14 | SK | SK | SKS | RS |
| 02 | 18-06-14 | AS PER TCE LETTER DATED- 16-05-14 | SK -SD- | SK -SD- | SKS -SD- | RS -SD- |
| 01 | 11-04-14 | AS PER TCE LETTER DATED- 29-10-13 | SK -SD- | SK -SD- | SKS -SD- | RS -SD- |
| REV. | DATE | REASONS FOR REVISION | DRN. | PREPARED BY | CHECKED BY | APPROVED BY |
| OWNER RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LIMITED | | | | | | |
| PROJECT 2X660MW THERMAL POWER PLANT, SURAT GARH STAGE -V, UNIT 7 & 8 AT SURATGARH, RAJASTHAN | | | | | | |
| OWNER'S ENGINEER TATA CONSULTING ENGINEERS LIMITED | | | | | | |
| EPC CONTRACTOR BHARAT HEAVY ELECTRICALS LTD TRANSMISSION BUSINESS GROUP | | | | | | |
| DEPT CODE | NAME | SIGN. | DATE | | | |
| 422 | DRN RK | -SD- | 14.08.13 | | | |
| | DESIGN SK | -SD- | | | | |
| | CHD SKS | -SD- | | | | |
| | APPD SS | -SD- | | | | |
| TITLE CONCEPTUAL CONTROL ROOM BUILDING LAYOUT FOR 400KV S/S AT SURATGARH | | | | | | |
| CV | ME | EL | I&C | DEPT. SCALE | BHEL/SUB VENDOR DRG NO. | |
| | | | | 1:600 | TB-3-360-316-009 | |
| | | | | SIGN | SHT. No 01 OF 03 | |
| | | | | DATE | REV. 03 | |

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

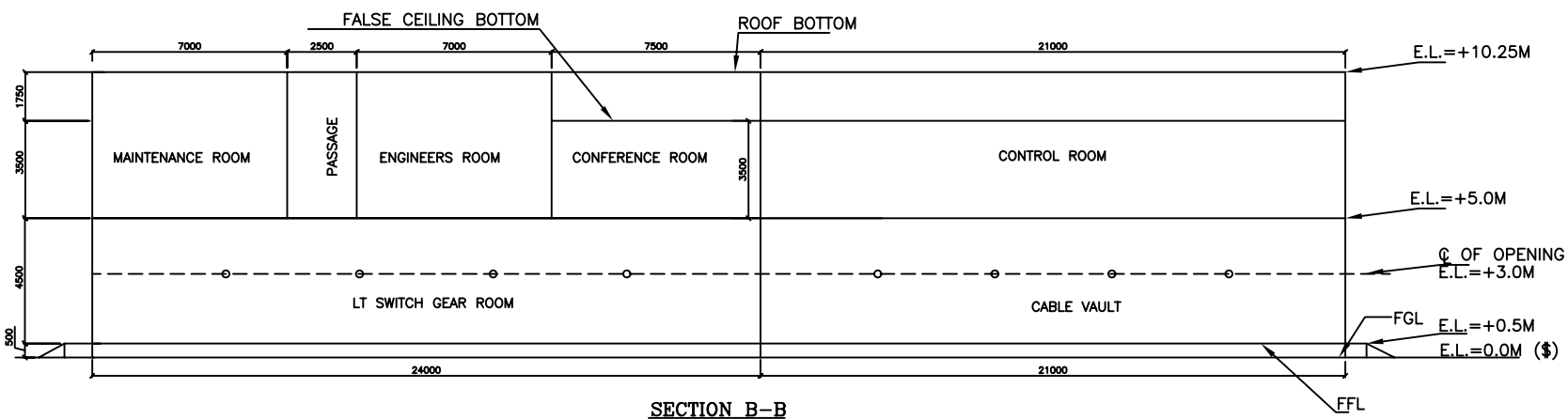
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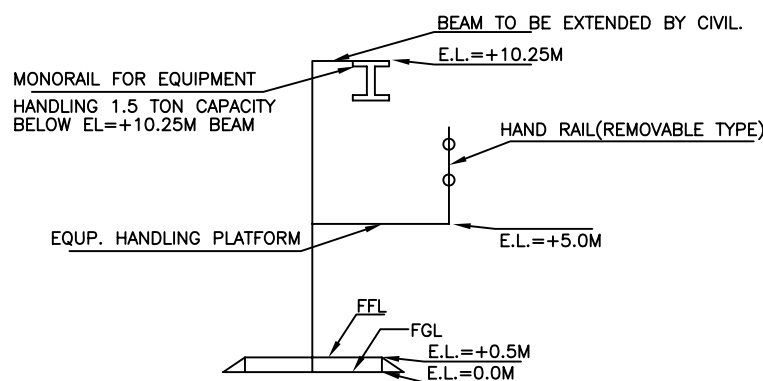
FIRST FLOOR PLAN AT E.L.=+5.0M



SECTION A-A



SECTION B-B



SECTION C-C

\$ = EL=0.0M IS EQUAL TO RL=193.0 M OF UNIT 7&8 SWITCHYARD.

| | | | | | | |
|----|----------|-----------------------------------|--------|--------|---------|--------|
| 03 | 05-08-14 | AS PER TCE LETTER DATED- 11-07-14 | SK | SK | SKS | RS |
| 02 | 18-06-14 | AS PER TCE LETTER DATED- 16-05-14 | SK-SD- | SK-SD- | SKS-SD- | RS-SD- |
| 01 | 11-04-14 | AS PER TCE LETTER DATED- 29-10-13 | SK-SD- | SK-SD- | SKS-SD- | RS-SD- |

| REV. | DATE | REASONS FOR REVISION | DRN. | PREPARED BY | CHECKED BY | APPROVED BY |
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OWNER
RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LIMITED

PROJECT
2X660MW THERMAL POWER PLANT, SURAT GARH STAGE -V, UNIT 7 & 8 AT SURATGARH, RAJASTHAN

OWNER'S ENGINEER
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| DEPT CODE | NAME | SIGN. | DATE |
|-----------|------|-------|----------|
| DRN | RK | -SD- | 14.08.13 |
| DESN | SK | -SD- | |
| CHD | SKS | -SD- | |
| APPD | SS | -SD- | |

TITLE
CONCEPTUAL CONTROL ROOM BUILDING LAYOUT FOR 400KV S/S AT SURATGARH

| | | | | | | |
|----|----|----|-----|-------|-------|-------------------------|
| CV | ME | EL | I&C | DEPT. | SCALE | BHEL/SUB VENDOR DRG NO. |
| | | | | | 1:600 | TB-3-360-316-009 |
| | | | | SIGN | | |
| | | | | DATE | | |

SHT. No 02 OF 03 REV. 03