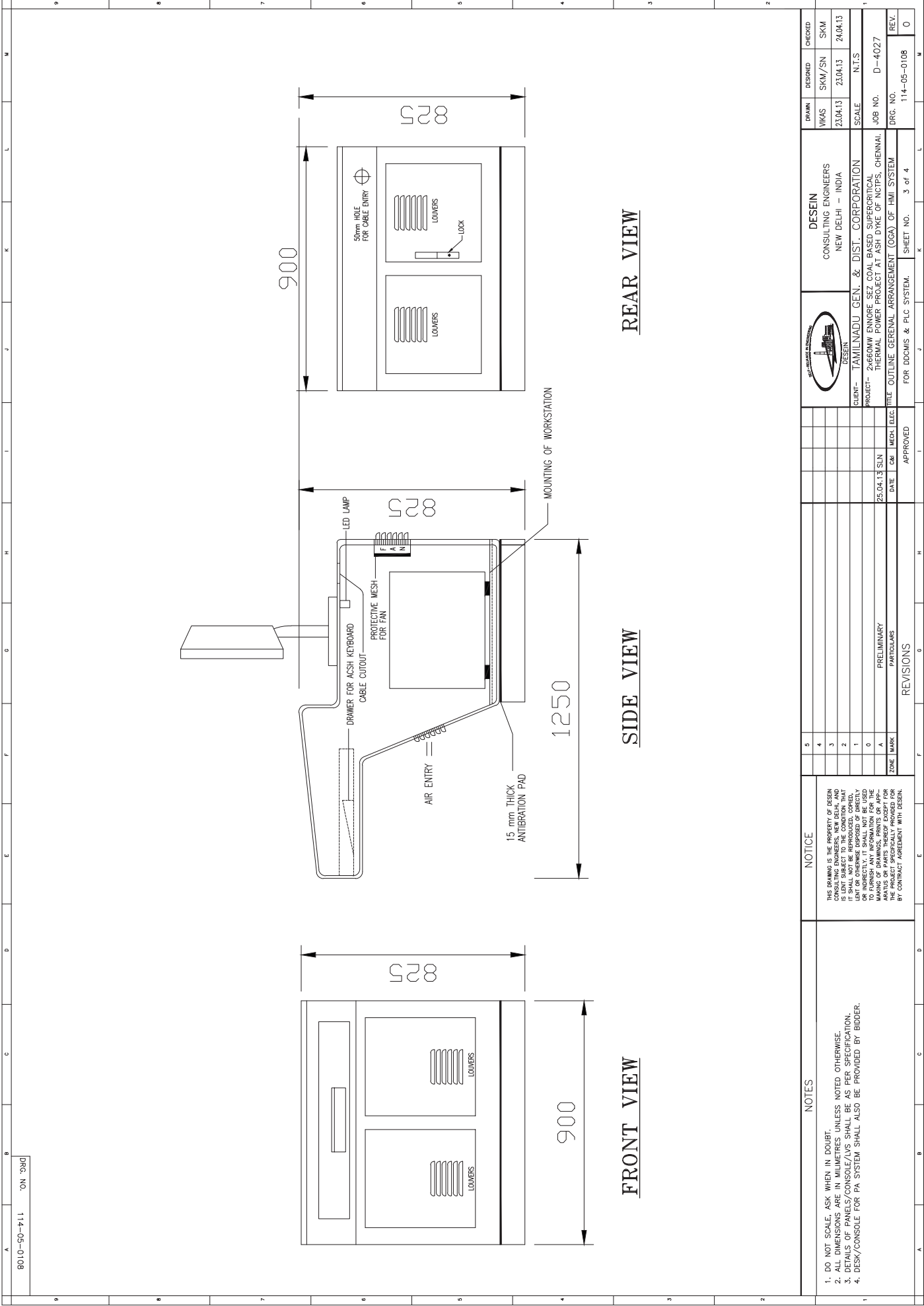
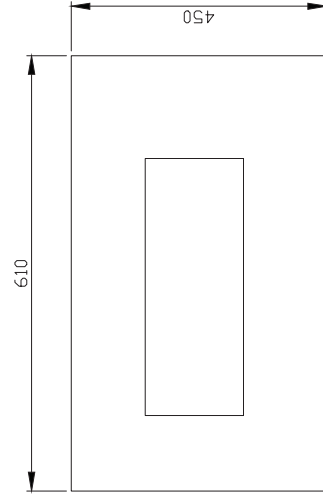
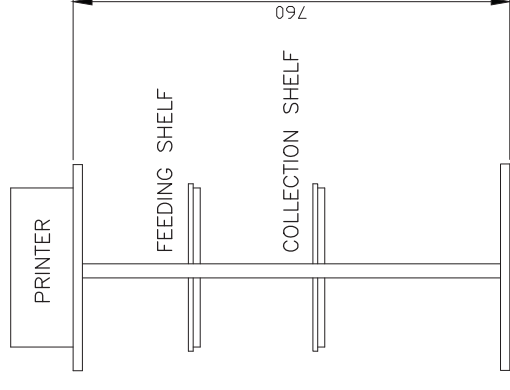
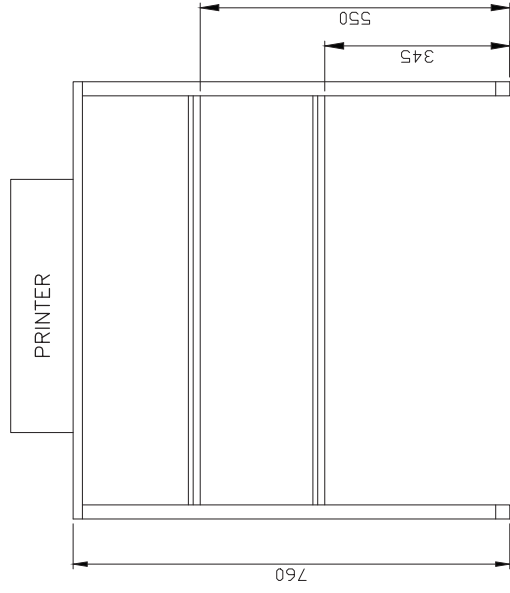






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# M.ERECTION HARDWARE

## **CHAPTER-9**

### **ERECTION HARDWARE**

#### **9.00.00 PROCESS CONNECTION AND PIPING**

##### **9.00.01 General Requirements**

This section covers the material requirement for instrument connection to process, instrument process, piping, tubing, supports, Instrumentation cables, control cables and power cables for connecting UPS, 24/48 V DC, unregulated power supply for cubicle illumination, compensating cables/Extension cables, transmitter racks and main accessories to be furnished under this specification and the requirements of installation and routing. Impulse lines, fittings and other accessories required for the erection of complete Instrumentation and Control System supplied under various packages of this specification shall be supplied on "as required" basis. Bidder shall offer all necessary items for this section based on his experience on similar plants, plant layout diagrams, installation drawings and other applicable sections of this specification. Based on the good engineering practices Bidder shall furnish installation drawings during the engineering of the system for Owner's review and approval. The installation of the drawings shall be suitable for his installation of his range of instrumentation.

The Bidder shall furnish and test all required erection hardware, which is necessary for proper installation and interconnection of the equipment/systems furnished by the Bidder and their integration with main equipment/systems as per the enclosed installation drawings and other applicable clause. The Bidder shall furnish all hardware and accessories to ensure that the equipment/systems furnished form a complete and operational system meeting the intent and requirement of this specification.

All materials, furnished shall conform to the latest editions of America National Standard Code for Pressure piping, Power piping, ANSI B311.1, ANSI B16.11, ASME Boiler and Pressure Vessel Codes, IBR and other applicable ASME, ANSI and Indian Standards. Schedule numbers, sizes and dimensions of all carbon steel, stainless steel and alloy seamless steel pipe shall confirm to ANSI B.36.10 and of stainless steel pipe shall confirm to ANSI B 36.19 unless otherwise specified.

All materials supplied under this section shall be suitable for intended service; process operating conditions and type of instruments used and shall fully conform to the requirements of this specification.

The Bidder is responsible for the performance of the equipment furnished on system basis any shortfall in erection material observed during erection stage shall be compensated by the Bidder at no extra cost. (Installation drawings # 114-04-0000, 0100 to 0113 shall also be referred by bidder).

#### **9.01.00 GUIDLINE FOR INSTALLATION AND ROUTING OF INSTRUMENT PIPING**

##### **9.01.01 General Requirements**

The following general erection guidelines have been enumerated here to enable the Bidder to estimate the requirement of instrument piping in plant:-

- i) All instrument piping shall be in accordance with good engineering practice. It shall be finalized during engineering stage. Instrument piping shall be complete with fittings, valves and other required accessories.
- ii) Instrument piping shall not be routed:-
  - a) Across equipment removal areas
  - b) Below mono-rails and cranes
  - c) Above or below removable gratings
  - d) Above or below cable trays.
- iii) Primary Impulse Piping System:
  - a) The primary impulse piping system shall include the instrument piping and all required accessories from process tap off point (root valves onwards) up to the respective instruments. From the same source, Tee off for instruments are not allowed. Separate tapping shall be provided for each instrument. The Bidder shall provide the necessary fittings and accessories along with impulse pipes for completeness and arrangements as per the finalized Instrument Installation Diagrams. Special accessories such as reservoirs and other devices shall be installed as required for flow primary element connection as required by the design of instruments, in accordance with the instructions of the instrument manufacturer.
  - b) The Bidder shall prepare impulse pipe routing drawings.
  - c) Impulse piping shall include a blow-down line and shut-off valve adequate for the duty requirements and for withstanding continuous design pressure and temperature of process medium. For process pressure above 40 Kg/Cm<sup>2</sup>g, double valves shall be used before connecting to the blow-down header (This arrangement shall be provided for installation for the new transmitter if the existing transmitter has the same arrangement.)
  - d) To assure a constant static head the connections from low pressure steam and low pressure liquid filled lines should preferably slope downward continuously towards the instrument as the instrument is mounted below the source point. If downward slope is not feasible or the instrument is mounted above the source point, the line should slope upward continuously and a "pigtail" installed at the instrument to assure a water seal for temperature protection. Upward sloping liquid lines should be used only if the process pressure is sufficient to assure a head of liquid at the instrument. Horizontal runs should have a slope of not less than 40 mm per meter and must be adequately supported to maintain a constant slope. Vacuum connections to the condenser should always slope upward to the instrument.
  - e) Primary process piping for steam flow, liquid flow and manometric level measurement systems should preferably slope downward from the primary element connections to the instrument. Primary piping for flue gas and air flow measurement systems should preferably slope upward from

the primary element connections to the instrument. If these requirements cannot be met, special venting or drain provisions will be required. Horizontal runs must have a slope of not less than 40 millimeters per meter and must be adequately supported to maintain a constant slope.

- f) Primary process piping from the field which enters the instrument enclosure from the bottom shall extend into the enclosure approximately 150 millimeters and be equipped with a socket weld to flare less tubing coupling of stainless steel. This coupling shall be used to connect the field primary process line to the enclosure process line. The field primary process line shall be anchored to the enclosure angle with U-bolts. Holes for supporting U-bolts shall be field or drilled.
- g) All impulse piping shall be supported rigidly at an interval not exceeding 1.5 meters so as to prevent excessive sag in piping. Process piping shall not be used for supporting impulse piping.
- h) Impulse lines subject to severe sonic pulsations such as boiler feed pump discharge, shall be of sufficient length and of suitable configuration to scatter harmful sonic wave energy before it reaches the instrument.
- i) Impulse piping shall be installed to permit thermal expansion without placing excessive stress on the piping and without affecting the gradient of slope. Long continuous straight runs of piping shall always be avoided. If required, expansion loops shall be provided at least every 2.5 meters to break the continuity.
- j) All welded and screwed fittings shall conform to ANSI B16.11. Threads of piping components shall be taper pipe thread in accordance with ANSI B2.1. All threads shall be clean machine cut with all burrs and chips removed. Lubricants shall be of dry film type. Any one of the following compounds may be used as a pipe thread sealer. Bidder shall supply adequate amount of his preferred sealer for erection purpose.
  - a) Permatex
  - b) Molycote
  - c) Neolube(Teflon tape shall not be used as a pipe thread sealer).

#### **9.01.02 Impulse Piping System**

Impulse piping system consists of primary impulse pipes/tubes, valves, fittings, valve manifolds and other accessories between the source connection point (source shut-off valve onwards) and all instruments/devices. Impulse pipe span for supporting clamp shall be 1.5 mtr. This will also include all piping and valves etc. required for instrument drain and vent connections. The Bidder shall furnish and test all items required for completeness of this specification.

#### **9.01.03 AIR SUPPLY PIPING**

The piping for air supply shall be as specified below (However the Bidder shall supply the materials as required basis to complete the system in all respect)

i) Individual Supply Lines and Control Signal Lines:-

Air lines shall be ¼ inch size, connected by brass/SS316 flare less tubing fittings. Copper/SS316 tubing shall be light drawn tempered tubing conforming to ATM B75 except copper tubing in tubing cables shall be annealed soft temper tubing conforming to ASTM B68 or B75. Fittings on the branch line to facilitate connections to the individual supply line shall be cast brass screwed type.

ii) Flexible Hoses:-

Flexible hoses shall be ¼ inch SS flexible hose pipe and with Buna-N liner steel wire braid reinforcement complete with ¼ inch brass/SS316 fittings and shall have swivel male pipe threads. Each hose shall be done meter in length.

iii) Pipe Material Specification:-

The piping material shall be carbon steel hot-dipped galvanized inside and outside as per IS-1239 or the equivalent of these standard heavy quality with screwed ends. The piping threads shall be as per ASA B.2.1.

iv) Isolating Valves:-

Gate valves as per ASTM B62 inside screw rising stem screwed female ends as per ASA B.2.1 valve bonnet shall be union type and trim shall be stainless steel body rating 150 pounds ASA. Valves sizes shall be ½ inch to 2 inch.

v) Fittings:-

Forged cast steel A234 Gr. WPM galvanized inside and outside; screwed as per ASA B2.1 dimensions as per ASA B16.11, rating 2000 pounds, elbows and soft seats. The size of the fittings shall be ½ inch through 2 inch.

vi) Air Filter Regulator Set:-

An instrument Air Filter Regulator Set with mounting assemblies shall be provided for each pneumatic device requiring air supply.

vii) Instrument Air Piping System:-

a) Instrument Air shall be made available by the bidder at 3.5 to 7.0 Kg/cm<sup>2</sup> pressure. The instrument air may be arranged as under:-

11. For the control valves and power cylinders in owner's scope but controlled by bidder's control system, the instrument air requirement for E/P converter shall be tapped from the nearby instrument air header laid by bidder / already laid existing piping with accessories available near the control valves or damper.

Complete hardware required for interfacing with Owner system shall be in bidder scope.

- b) Air supply piping shall be installed at site always with a slope of over 1/100 to prevent accumulation of condensed water within the pipe.
- c) All joints in the instrument air sub-header shall be of screwed type.
- d) Instrument air line shall be separate for each individual instrument, equipment & drive with own isolation valve and other required hardware. Tee off of instrument line for two or more same/similar services instrument, equipment & drive are not acceptable.
- e) Instrument air flushing/purging lines shall be provided for Bowl Mill DP, secondary air flow measurement instrument and other all flue gas services instruments etc.

viii) Signal / Control Air Tubing System:-

Necessary tubes with fittings and accessories for output signal from pneumatic instruments mounted in the field and control signals to final control elements shall be covered under this tubing system.

## 9.02.00 **SPECIFICATION FOR ERECTION HARDWARE**

The erection hardware shall meet the following specifications:-

|                | <b><u>Item</u></b>                                                                        | <b><u>Specification</u></b>                                                                                |
|----------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| <b>9.02.01</b> | <b>Impulse Piping</b>                                                                     |                                                                                                            |
| i)             | High pressure and high temperature services<br>(Medium: Steam & Water and furnace region) | Seamless Alloy Steel piping to ASTM A335 GR.P91/22 (schedule XXS/160 for high pressure & high temperature) |
| ii)            | Low pressure and low temperature services<br>(Medium: Steam & Water)                      | Seamless carbon steel piping to STM A106, Gr.C                                                             |
| iii)           | Low pressure and low temperature services<br>(Air, Flue gas)                              | ERW carbon steel piping to IS 1239:1973 Heavy class System)                                                |
| iv)            | Steam and water analysis system                                                           | Seamless stainless steel piping to ASTM A312 GR. TP-321                                                    |
| v)             | Seamless copper tubing                                                                    | ASTM B-75                                                                                                  |

### 9.02.02 Fittings Double compression type

- |      |                                        |                                                     |
|------|----------------------------------------|-----------------------------------------------------|
| i)   | Material for socket weld fittings      | ASTM A105<br>ASTM A182,<br>Gr. F22<br>6000/3000 lbs |
| ii)  | Dimensions of fittings                 | ANSI B16.11                                         |
| iii) | Fittings for steam and water analysis. | Gr. F-321                                           |

### 9.02.03 Valves

- |      |                            |                                                                                                                                                                    |
|------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| i)   | 3 – way valves             | SS body/forged CS<br>body stellited internals and SW ends<br>as per requirement for 2500 lb/800 lb<br>ASA ratings.                                                 |
| ii)  | 5- valve manifolds         | FAS body/FCS body<br>316SS stellited internals with NPT(F)<br>SCRD ends for 3000/2500 lb/1500<br>lb/800 lb ASA ratings. Construction –<br>Single block (Bar stock) |
| iii) | 3-valve manifolds          | FAS body/FCS body<br>316SS stellited internals with NPT(F)<br>SCRD ends for 3000/2500 lb/1500<br>lb/800 lb ASA ratings. Construction –<br>Single block (Bar stock) |
| iv)  | 2-valve manifolds          | FCS body, 316SS<br>stellited internals, NPT(F) SCRD<br>ends. Construction – Single block<br>(Bar stock)                                                            |
| v)   | Isolation and drain valves | Globe valves with<br>FAS body/FCS body, 316SS stellited<br>internals SW ends for 3000/2500<br>lb/1500 lb/800 ASA ratings.                                          |

- |         |                      |                                                                                                       |
|---------|----------------------|-------------------------------------------------------------------------------------------------------|
| 9.02.04 | Condensation vessels | FAS/FCS body with NPT (F) SCRD<br>connection and vent plugs for 3000/2500/1500/800<br>lb ASA ratings. |
|---------|----------------------|-------------------------------------------------------------------------------------------------------|

- |         |                                |                 |
|---------|--------------------------------|-----------------|
| 9.02.05 | Racks and Associated Equipment | ANSI C83.9-1972 |
|---------|--------------------------------|-----------------|

- |         |                                                           |             |
|---------|-----------------------------------------------------------|-------------|
| 9.02.06 | Code for pressure piping, welding and Hydrostatic testing | ANSI B-31.1 |
|---------|-----------------------------------------------------------|-------------|

- 9.02.07** Flexible conduits with fittings      Lead coated, paper insulated, heat resistant flexible metallic conduits with necessary fittings.
- 9.02.08 3 Valve manifold shall be used, wherever Diff Pressure transmitter/switch have been used for pressure measurement.
- 9.02.09 5 Valve manifold shall be used for Diff. Pressure & Flow measurement Transmitters/Switches.
- 9.02.10 In addition to above, table # 9.1 shall also be followed for selection of specific erection hard ware as per process requirements.

### **9.03.00 TRANSMITTER & SWITCHES ENCLOSURES**

In general, BTG process transmitters & switches installed at outdoor location and in areas where they are subjected to splashing oil, water, steam etc., shall be mounted in closed type transmitter rack. For other areas (indoor), open type racks may be used for installation of transmitters and process switches. However the actual requirement shall be finalized during detailed Engineering considering following:-

- i) Transmitter/Switches enclosures shall be free standing, enclosed type offering protection against dust, moisture and vermin. Enclosures shall be suitable for outdoor installations, in thermal power plants.
- ii) The enclosures shall comprise of Galvanized Sheet mounting plate internally. Also external-mounting brackets in Polyamide or Stainless Steel shall be available. Alternatively transmitter enclosures can be glass Fiber Reinforced Polyester (GRP) compression moulded and shall be weather proof.
- iii) Instrument piping inside the enclosure shall conform to the specification and in line with typical installation drawings enclosed with the specification.
- iv) Blow down header shall be provided inside the enclosure as called for.
- v) Bulk head connection shall be provided to receive and terminate the impulse pipes from root valves.
- vi) Instrument tubing, fittings and isolation, drain valves shall be to ANSI code for pressure piping. Piping/tubing shall be subject to hydrostatic tests at 1.5 times maximum system pressure.
- vii) Support angles shall be provided for valve manifolds, wiring trays etc. Enclosures shall be complete with necessary bulk head fittings, junction boxes, drain header and other accessories as needed on the basis of approved hook up drawings.
- viii) Sufficient spacing among adjacent transmitters shall be maintained to offer easy accessibility and operational convenience. The enclosure shall be designed with sizes to suit the grouping and to completely include all the hardware for hooking up

the transmitters to the process on the basis of approved installation diagrams. A maximum of five (5) transmitters are envisaged to be grouped in one enclosure.

- x) A minimum of twenty (20) percent spare terminals shall be provided. Only one wire per terminal shall be used on the outgoing side of these blocks (for cable panel). Any common connections required shall be provided on the panel side of the block. All incoming power terminals are to be clearly identified in a manner distinctly different from all other terminals and grouped in a logical pattern.
- xi) Chapter no. 6 of this volume shall also be referred for designing of Transmitter/Switches enclosures.

#### 9.04.00

#### LOCAL INSTRUMENTS, LOCAL BOARDS AND TAPPING POINTS

- i) All local gauges as well as sensors, Transmitters and switches any other instruments for parameters like pressure, temperature, level, flow etc for safe and efficient operation of equipment under the scope of specification, shall be provided by bidder as approved by Owner. Such equipment shall be listed by the Bidder detailing the items with the respective functions in service. All field mounted instruments shall be mounted in such a way as not to be affected by vibration & environmental conditions. Racks to mount these instruments shall be furnished by bidder complete with requisite erection hardware, tubings and junction boxes with all terminals of the instruments duly wired complete with cable glands. Groupings of instruments, actual number of racks for instruments and its construction shall be to Owners approval.
- ii) Transmitters & Switches provided shall be mounted in transmitter/Switches enclosures to owner's approval. The junction box for electrical connections shall be outside the transmitter enclosures.
- iii) All erection hardware required for complete installation/ implementation of entire instrumentation specified is included in bidders scope. Any change in size, type, rating or in quantity deemed necessary during engineering shall be supplied within package price with no additional financial implication to owner.
- iv) Bidders scope includes providing counter flanges on pipe lines/ vessels to suit owner arranged flanged devices. Counter flanges shall be complete with gaskets, nuts, bolts and other requisite accessories for proper installation.
- v) Separate and independent tapping on equipment/associated piping shall be provided to suit the philosophy of redundant primary sensors. Separate sensors for control and monitoring etc are as decided by Owner. This shall include application such as first stage pressure. Wherever the process value being measured needs to be compensated for temp, pressure variations, the tapping points for such compensating elements shall be provided in requisite number along with the tapping for the process value.
- vi) Whereever transmitters & switches are provided, in addition Local gauges shall also be provided by bidder for local field monitoring.

- vii) Local instruments and remote sensors & transmitters to be furnished with the equipment shall generally be as indicated herein and as per redundancy criteria indicated elsewhere but not be limited to the following: -

## 1. Pressure Measurement

### i. **Pressure Gauge** for:

- a) Shell pressures of all Deaerator, HP and LP heaters and other vessels.
- b) Mercury manometers shall be provided during air outlet flows measurement.
- c) Bleed steam pressure at extraction point for all turbine extractions and for pressure on drain lines.
- d) Pressure gauges at inlets and outlets of condensate extraction pumps, main oil pump, each auxiliary oil pump, AC standby oil pump, DC Emergency oil pump, jacking oil pumps, DM makeup pumps, DMCW pumps, BFP, or any other pumps etc.  
Pressure Gauge at outlet of each type of Fan.
- e) Lube oil pressure before and after oil coolers, HPT & IPT front seal chamber leak off pressure.
- f) MS pressure downstream of ESV, after HPT control valves and after HPT first stage, HRH steams pressure after IV, Gland steam header pressure, HPT exhaust etc.
- g) Condensate pressure in condensate pump discharge header, and feed water pressure at inlet and outlet of each LP & HP heaters.
- h) LP turbine exhaust pressure and condenser pressure
- i) Relay/Lube/Control oil pressure, Drain oil lines pressure.
- j) Pressure gauges for vacuum pumps and each pump discharge.
- k) Pressure gauge at Instrument and service air header in compressor room and in the field at the main location of instrument/service air header, the pressure gauges shall be provided.
- l) Pressure gauges at inlet and outlet of each heat exchanger and cooler.
- m) Frame mounted Pressure Gauges (FMG) shall be provided for Main steam Pressure, Feed water pressure to economizer, CRH Steam Pressure, HRH Steam Pressure etc.
- n) For condensate storage tank the pressure gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300 mm or bigger size** shall be provided.
- o) **U tube manometer with Hg filled for direct measurement of condenser vacuum** shall be provided in the fixed with isolation valve for local indications.
- p) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering by owner.
- q) Pressure gauge for all BoP packages as decided during detailed engineering by owner.

### ii. **Pressure Switches**

- a) Pressure switches at condensate Extraction Pump Discharge header, Boiler feed pump, seal water line or any other pumps for alarm (high & low) and interlock purpose.

- b) Pressure switches for steam supply to LP/HP heaters.
- c) Pressure switches for initiation of turning gear.
- d) Pressure switches for control oil, jacking oil and lube oil pressure for all required alarms and interlocks.
- e) Steam pressure downstream of ESV, steam pressure after first stage of HPT, gland steam header pressure and suction line from turbine glands to Gland cooler.
- f) Pressure switches for condenser vacuum low, very low alarms & interlocks.
- g) Condenser water box pressure for alarm interlocks.
- h) Pressure switches (low & high) for individual pumps/blowers suction/discharge and discharge header – alarms, interlocks and protection
- i) At the main location of instrument air header the pressure low switches shall be provided for alarms in DDCMIS
- j) Pressure switches/any other process switch etc. for OLCS / Alarms / Interlocks / Protection. Pressure switches at inlet, outlet of individual pumps and discharge header of pumps for protection and auto start / stop & alarms.
- k) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria by owner.
- l) Pressure switches for all BoP packages as decided during detailed engineering. by owner.

iii. **Differential Pressure Transmitters, Diff Pressure Switches & Diff. Pressure Gauges**

- a) Pressure across strainers and filters.
- b) Diff. Pressure Transmitters/switches/Gauges for all BoP packages as decided during detailed engineering by owner.
- c) Diff. Pressure Transmitter across condenser on CW lines, Air pre heaters on air & flue gas lines, on PA lines, CEP suction strainers, Feed control station etc.
- d) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria by owner.

iv. **Pressure Transmitters**

- a) For all services as mentioned for Pressure gauges & Pressure Switches.
- b) Pressure Transmitters at condensate Extraction Pump individual Discharge and discharge header, Boiler feed pump individual Discharge and discharge header, seal water line or any other pumps/fans/HT/LT unidirectional drive for alarm (high & low) and interlock purpose.
- c) Pressure transmitter for wind box (Left/Right) & pulverizer seal air fans discharge pressure.
- d) Pressure Transmitters as on required basis for monitoring, interlocks & controls as per redundancy criteria and approved by owner.
- e) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria and approved by owner.
- f) Pressure Transmitters for all BoP packages as decided during detailed engineering by owner.

## 2. Temperature Measurements:-

The Bidder shall furnish all temperature sensing elements to be installed in their piping. The scope of supply shall include, but not limited to the following: -

- i) Duplex RTDs for all bearing, drain oil from bearings, LPT exhaust steam, 3 no's of duplex RTDs each on left and right CW outlet of condenser etc.
- ii) 6 no. duplex or 12 no. simplex Embedded temperature detectors for various motor stator windings and duplex RTDs for Motor/Pump bearing temp.
- iii) Chromel-alumel surface/other thermocouples for turbine casings, ESV, IV bodies, superheated steam, hot reheat steam piping, steam of first stage HPT, inlet bowl of IPT, steam exhaust of HPT, down stream of ESV and IV, steam in ESVs and IVs, steam admission pipes metal temperatures, HPC, IPC flange metal temperature etc.
- iv) For all HP heaters remote monitoring with redundant independent sensors of inlet/outlet temperatures of feed water and extraction steam shall be provided in addition to local gauges.
- v) For all LP heaters remote monitoring with redundant independent sensors of inlet/outlet temperatures of feed water and extraction steam shall be provided in addition to local gauges.
- iv) Temperature sensors for HP-LP bypass system for measurement as well as for control.
- v) Adequate number of temperature Elements shall be furnished to provide initiating contacts for temperature interlocking and trip circuits. The temperature elements shall be provided, but not limited to the following: -

Steam temperature of HPT exhaust, steam temperature after ESV (L&R), IV (L&R), LPT exhaust hood steam, drain oil temperature of all journal bearings and thrust bearing & lube oil header temperatures, thrust bearing of each condensate extraction pump and vacuum pump protection, interlocks.

- vi) Metal Temp measurement and steam temp measurement at each super heater & Reheater location.
- vii) Temp. Element & Temp gauges at Feed water line to economizer inlet, economizer to steam separator, spray water lines to desuperheaters, Soot blower steam, Soot blower steam drain lines, steam drain lines, Flue gas & air lines etc
- viii) Temp. Measurements (Local & remote) for all BoP packages as decided during detailed engineering.
- ix) Thermocouples for Temp. above 200 deg C shall be provided by bidder.
- x) For plate heat exchangers, spare thermowell provision shall be made at inlet & outlet of ACW & DMCW lines in addition to local & remote temperature monitoring points.
- xi) Each ESP Hopper shall be provided with RTDs to control the temperature of ash through Hopper heater.

### xii) Temperature gauges.

- a) For bearing temperatures AC and DC lube oil pumps, LPT exhaust hood etc.
- b) For condensate and feed water at inlet and outlet of HP heaters, Vacuum pumps, LP heaters etc.

- c) Steam & water inlet/outlet of LP and HP heaters, steam and air mixture inlet to vacuum pumps, and drain lines etc.
- d) Journal/thrust bearing drain oil, lube oil at inlet/outlet of oil coolers, cooling water at inlet and outlet of oil coolers etc.
- e) Thrust bearing of each condensate extraction pump.
- f) Temp. Gauges at inlet and outlet of each heat exchanger and cooler.
- g) Frame mounted Temperature Gauges (FMG) shall be provided for Main steam Temperature, Feed water Temperature to economizer, CRH Steam Temperature, HRH Steam Temperature etc
- xiii) Above are the min. requirements, actual quantities shall be as decided during detailed engineering by owner.

### 3. Level Measurement

- i) Level gauges - level gauges for boiler separator, HP heaters, LP heaters, deaerator, drain cooler, gland steam cooler, vacuum tanks, condenser hot well CBD tank, stator water tank, Stator water expansion tank and other pressure vessels, main oil tank and all oil tanks in BTG & BOP package. The level gauges shall be mica shielded steel armoured transparent glass type. Level gauges for condenser hot well shall be provided on both sides.
- ii) Level switches for HP/LP heaters, drain cooler, gland steam cooler, condenser hot well, deaerator, main oil tank and other pressure vessels, tanks, sumps etc. The separate switches for high, very high and low levels shall be provided as per interlocks and protection requirements.

External cage mounted magnetic level switches/ displacer type shall be employed for low pressure & low temp. services.

However conductivity type level switches shall be provided for high pressure & high temp services like HP heaters, CRH/HRH drain Pot, Turbine Drains etc.

- iii) Level Transmitters (Type as per Owner approval) for open sump/tank/bunker/vessel/heaters.
- iv) Level measurement for all BoP packages as decided during detailed engineering.
- v) Level switches for OLCS / Alarms / Interlocks / Protection. Level switches for sump/tank level high/normal/ low/very low interlocks.
- vi) Each ESP hopper must be provided with 3 nos. level switch (switches 2 nos. for high level and One no. for low level.)
- vii) Above are the min. requirements, actual quantities shall be as decided during detailed engineering by owner.

### 4. Flow Measurements:-

- a) Primary Elements: Flow nozzles shall be used for feed water flow and other critical measurements where weld-in construction is required. Flow nozzles shall be made of stainless steel, with three sets of pressure taps installed in the pipe wall where required. One no. spare set of pressure tap shall also be provided on flow nozzle,

wherever required. Installation of flow nozzles and pressure taps shall be made in the pipe fabricator's shop and shall be witnessed by a representative from the flow nozzle manufacturer.

- b) Paddle type orifice plates shall be used for other flow measurements where flanged construction and higher pressure loss are acceptable. Orifice plates shall be made of stainless steel. Orifice flanges shall be of the raised face weld neck type with dual sets of taps.
- c) Construction and installation of flow nozzles and orifices shall conform to the requirements of ASME Performance Test Code PTC-19.5, and discharge coefficients shall be predicted in accordance with data published in ASME Research Report on Fluid Meters.
- d) Airfoil or venturi flow sections, shall be used for measuring boiler combustion airflow.
- e) A special high accuracy flow nozzle pipe shall be provided to determine feed water flow to the economizer. This nozzle shall be hydraulically calibrated and utilized for feed water flow control and for turbine testing as described in ASME PTC 6 (latest revision).
- f) Orifice plates shall be supplied with carrier rings as per process requirement.
- g) Doppler effect type flow meters shall be used for sludge applications.
- h) For Raw water, water treatment plant and effluent treatment plant, ultrasonic type flow meters to be used.
- i) Secondary Elements: Secondary elements for differential type flow sensors shall be strain gauge or capacitance type differential pressure transmitters. Square root extraction required for the DP transmitters shall be performed electronically in the transmitter itself.
- j) HFO/LDO flow meters shall be based on coriolis mass flow technology. Fuel Oil meters shall be provided for fuel oil unloading system and near boiler after day oil tank (at main supply & return line).
- k) Flow nozzles shall be provided for following services in main plant:-
  - i) Steam flow measurement for BFP Turbines.
  - ii) Feed water flow measurement
  - iii) Auxiliary steam flow measurements
  - iv) HP bypass flow measurements
  - v) BFP suction flow.
  - vi) Deaerator water flow measurement
  - vii) HP heaters drain Flow measurements.

Orifices shall be provided for following services:-

- i) Spray water flow measurement

- ii) Condensate flow measurements
  - iii) DM/hotwell makeup to condenser.
  - iv.) Condensate dump flow to CST
  - v) Gland Steam Condensate flow measurements
- l) For DM water flow & Ash Slurry flows measurements online electromagnetic flow meter shall be used.
  - m) At CW & ACW pump discharge headers flow transmitters shall be provided (Non Contact ultrasonic Type are preferable). In addition flow measurement shall also be provided for CW water used any where except condenser service.
  - n) Instrument and Service Air - Vortex/Swirl type Flow meter
  - o) Flow transmitters for general applications shall be of the differential pressure type
  - p) Flow switches for OLCS / Alarms / Interlocks / Protection.
  - q) Lubricating oil Flow transmitter/meter with switch shall be provided for Bearing systems of APH, FD, PA, etc.,
  - r) Sight glasses flapper indication type shall be provided on lube oil cooling water piping as required to ensure indication of fluid flow.
  - s) On line Fuel flow & velocity measurement facility in each Pulverized Fuel (PF) pipe for each coal pulveriser shall be provided by bidder for accurate, absolute and simultaneous measurement of coal velocity, coal density, coal mass flow rate and air-to-fuel ratio. The equipments shall comprise of sensors working on micro wave technology.
  - t) In addition to the **conventional triple DP measurement techniques** involving venturi/Airfoil for secondary air flow measurement, One number **Flow measurement** system each on Left side and Right side shall be provided **as redundant/checking measurement for secondary air flow** which could be used in the optimization package.
- On line secondary air flow & velocity measurement facility in each on left side & right side shall be provided by bidder for accurate, absolute and simultaneous measurement of air velocity & flow rate. The equipments shall comprise of sensors working on tribo-electric (Correlation technique) technology.
- u) Any other flow element/meter required for system shall be finalised as per system requirement and as per approved drawings/documents by owner.

9.05.00

### **Process Connections**

The type of instrument source connection shall depend upon the process parameters and the tapping size. The source connection drawings shall be finalised during the engineering stage.

Size of tapping point stub, number and size of root valves for different types of measurements are as follows:

| Sl. No.                                                      | Quantity of root valves | Size of stub and root valve | Service Condition                                 |
|--------------------------------------------------------------|-------------------------|-----------------------------|---------------------------------------------------|
| <b>Pressure and Differential Pressure Measurement</b>        |                         |                             |                                                   |
| (i)                                                          | 2                       | 25NB                        | $\geq 40 \text{ bar(g)}$ OR $425^{\circ}\text{C}$ |
| (ii)                                                         | 1                       | 15NB                        | $< 40 \text{ bar(g)}$ AND $425^{\circ}\text{C}$ . |
| <b>Level Measurement</b>                                     |                         |                             |                                                   |
| <b>(a) Level Gauge &amp; Switch</b>                          |                         |                             |                                                   |
| (i)                                                          | 2                       | 25NB                        | $\geq 40 \text{ bar(g)}$ OR $425^{\circ}\text{C}$ |
| (ii)                                                         | 1                       | 25NB                        | $< 40 \text{ bar(g)}$ AND $425^{\circ}\text{C}$   |
| <b>(b) Level transmitter (displacement type)</b>             |                         |                             |                                                   |
| (i)                                                          | 2                       | 40NB                        | $\geq 40 \text{ bar(g)}$ OR $425^{\circ}\text{C}$ |
| (ii)                                                         | 1                       | 40NB                        | $< 40 \text{ bar(g)}$ AND $425^{\circ}\text{C}$   |
| <b>(c) Stand pipe for level measuring instrument</b>         |                         |                             |                                                   |
| (i)                                                          | 2                       | 80 NB                       | $\geq 40 \text{ bar(g)}$ OR $425^{\circ}\text{C}$ |
| (ii)                                                         | 1                       | 80 NB                       | $< 40 \text{ bar(g)}$ AND $425^{\circ}\text{C}$   |
| <i>Flow Measurement</i>                                      |                         |                             |                                                   |
| (i)                                                          | 2                       | 25NB                        | $\geq 40 \text{ bar(g)}$ OR $425^{\circ}\text{C}$ |
| (ii)                                                         | 1                       | 25NB                        | $< 40 \text{ bar(g)}$ AND $425^{\circ}\text{C}$   |
| <b>Sampling system measurement (Steam and Water Service)</b> |                         |                             |                                                   |
| (i)                                                          | 2                       | 25 NB                       | $\geq 40 \text{ bar(g)}$ OR $425^{\circ}\text{C}$ |
| (ii)                                                         | 1                       | 25 NB                       | $< 40 \text{ bar(g)}$ AND $425^{\circ}\text{C}$   |

## N. VENDOR LIST

# Customer Vendor List

## 2X660 MW Ennore SEZ SUPERCRITICAL TPS

| Sl. No.                                               | Package Name         | Vendor Name                       | Remarks            |
|-------------------------------------------------------|----------------------|-----------------------------------|--------------------|
| <b>CONTROL AND INSTRUMENTATION (C&amp;I) PACKAGES</b> |                      |                                   |                    |
| 1                                                     | ANUBAR ( DELTA TUBE) | STAR-MECH CONTROLS (I) PVT.LTD.   | Approved           |
|                                                       |                      | TM TECNOMATIC SPA                 | Submit credentials |
|                                                       |                      | SWITZER INSTRUMENT LTD.           | Approved           |
| 2                                                     | CONTROL VALVE        | RINGO VALVULAS S.L,               | Submit credentials |
|                                                       |                      | Severn Glocon India Pvt. Ltd.     | Submit credentials |
|                                                       |                      | CONTROL COMPONENT INC.            | Approved           |
|                                                       |                      | DRESSER VALVE INDIA PVT. LTD      | Submit credentials |
|                                                       |                      | LESLIE CONTROLS, INC              | Submit credentials |
|                                                       |                      | SPX Corporation, USA              | Submit credentials |
|                                                       |                      | Daume Regelarmaturen GmbH,        | Submit credentials |
|                                                       |                      | INSTRUMENTATION LTD.              | Approved           |
|                                                       |                      | Valvitalia S.P.A. ,               | Submit credentials |
|                                                       |                      | WEIR VALVES & CONTROLS UK LTD.    | Approved           |
|                                                       |                      | Koso India Private Limited,       | Submit credentials |
|                                                       |                      | FORBES MARSHALL ARCA PVT.LTD.     | Approved           |
|                                                       |                      | R.K.CONTROL INSTRUMENTS PVT. LTD. | Approved           |

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|   |                           |                                               |                    |
|---|---------------------------|-----------------------------------------------|--------------------|
|   |                           | EMERSON PROCESS MANAGEMENT<br>CHENNAI LIMITED | Approved           |
|   |                           | HOLTER REGELARMATUREN GmbH &<br>Co.KG         | Submit credentials |
|   |                           | MIL CONTROLS LTD.                             | Approved           |
|   |                           | SHENJIANG VALVE CO. LTD.                      | Submit credentials |
|   |                           | Metso Singapore PTE. LTD.,                    | Approved           |
| 3 | FLOW ELEMENT -<br>NOZZLE  | HYDROPNEUMATICS PVT. LTD.                     | Approved           |
|   |                           | INSTRUMENTATION LTD.                          | Approved           |
|   |                           | MICRO PRECISION PRODUCTS PVT. LTD.            | Approved           |
|   |                           | STAR-MECH CONTROLS (I) PVT.LTD.               | Approved           |
|   |                           | SEIKO FLOW CONTROL GMBH                       | Approved           |
| 4 | FLOW ELEMENT -<br>ORIFICE | MICRO PRECISION PRODUCTS PVT. LTD.            | Approved           |
|   |                           | INSTRUMENTATION LTD.                          | Approved           |
|   |                           | HYDROPNEUMATICS PVT. LTD.                     | Approved           |
|   |                           | Flow Star Engineering Pvt. Ltd.,              | Approved           |
|   |                           | STAR-MECH CONTROLS (I) PVT.LTD.               | Approved           |
|   |                           | MINCO (INDIA) PRIVATE LIMITED                 | Approved           |
|   |                           | INSTRUMENTATION ENGINEERS PVT LTD             | Approved           |

|   |                               |                                          |                    |
|---|-------------------------------|------------------------------------------|--------------------|
| 5 | PROGRAMMABLE LOGIC CONTROLLER | GE Intelligent Platforms Private Limited | Approved           |
|   |                               | SIEMENS LIMITED                          | Approved           |
|   |                               | ROCKWELL AUTOMATION INDIA LTD            | Approved           |
|   |                               | SCHNEIDER ELECTRIC INDIA PVT.LTD.        | Approved           |
|   |                               | Honeywell Automation India Limited       | Approved           |
| 6 | ROTAMETER                     | FLOWTECH INSTRUMENTS SERVICES            | Approved           |
|   |                               | Flow Star Engineering Pvt. Ltd.,         | Approved           |
|   |                               | EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.    | Approved           |
|   |                               | SCIENTIFIC DEVICES (BOMBAY) PVT LTD,     | Approved           |
|   |                               | INSTRUMENTATION ENGINEERS PVT LTD        | Approved           |
| 7 | ULTRASONIC FLOW TRANSMITTERS  | New Package                              |                    |
| 8 | SIGHT FLOW INDICATORS         | TELACE EQUIPMENT PVT.LTD.                | Submit credentials |
|   |                               | BLISS ANAND PVT. LTD.                    | Approved           |
|   |                               | B.K.EQUIPMENTS PVT.LTD.                  | Approved           |
|   |                               | SIGMA INSTRUMENTS CO.                    | Approved           |
|   |                               | FLOWTECH INSTRUMENTS SERVICES            | Approved           |
|   |                               | INSTRUMENTATION ENGINEERS PVT LTD        | Approved           |
|   |                               | SCIENTIFIC DEVICES (BOMBAY) PVT LTD,     | Approved           |

**PACKAGE CATEGORY – CONTROL & INSTRUMENTATION**

| SL. NO. | ITEM          | VENDOR NAME                                                                                                                                                                                                   |
|---------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.      | CONTROL VALVE | DeZURIK – COPEL VULCAN LTD., U.K<br>CONTROL COMPONENT INC., USA<br>DRESSER VALVE INDIA PVT. LTD<br>FISHER SANMAR LIMITED<br>INSTRUMENTATION LTD.<br>FORBES MARSHALL ARCA PVT.LTD.                             |
| 2.      | FLOW ELEMENT  | BRISTOL BABCOCK LTD., U.K<br>BALIGA LIGHTING EQUIPMENTS PRIVATE LIMITED, CHENNAI<br>ENGINEERING SPECIALITIES PRIVATE LTD<br>INSTRUMENTATION LTD<br>MICRO PRECISION PRODUCTS<br>STAR-MECH CONTROLS (I) PVT.LTD |

**PACKAGE CATEGORY: CIVIL**

|     |                                               |                                                                                                |
|-----|-----------------------------------------------|------------------------------------------------------------------------------------------------|
| I   | VIBRATION ISOLATION SYSTEM                    | GERB SCHWINGUNGSISOLIERUNGEN GmbH & CO. KG                                                     |
| II  | VIB FOR MILLS/ FANS/ FOUNDATIONS/ SUPERVISION | GERB VIBRATION CONTROL SYSTEMS PVT LTD                                                         |
| III | WEIGH BRIDGE                                  | TECHNO SCALE INDUSTRIES, AHMEDABAD<br>SOUTHERN SCALES COMPANY, NASIK<br>IPA PVT LTD, BANGALORE |

**PACKAGE CATEGORY: MECHANICAL AUXILIARY (2<sup>nd</sup> ADDN LIST)**

|    |                     |                                                                                                                                                                                                                                                                                                             |
|----|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I  | ASH HANDLING SYSTEM | MELCO INDIA PVT. LTD., FARIDABAD<br>DRIPLEX WATER ENGG. LTD.<br>DC INDTL. PLANT SERVICES PVT. LTD.<br>INDURE PVT. LTD.<br>MAHINDRA ASHTECH LTD.<br>McNALLY BHARAT ENGG. CO. LTD.<br>MACAWBER BEEKAY PVT. LTD.<br>UNITED CONVEYOR CORPORATION, USA<br>UNITED CONVEYOR CORPORATION (INDIA) PVT. LTD., KOLKATA |
| II | CHIMNEY ELEVATORS   | AVON CRANES PVT. LTD.                                                                                                                                                                                                                                                                                       |

*[Signature]*

EXECUTIVE ENGINEER/PROJECTS  
TAMILNADU ELECTRICITY BOARD  
5th FLOOR, NPKRR MAALIGAI  
144, ANNA SALAI, CHENNAI-600 022

# BHEL Vendor List

## PEM REGISTERED VENDOR

| SLNO | Package Code | Package Name                          | Vendor Code | Vendor Name                                 | Reg Status | Grade | Vendor Address                                                                                                                                                                            | Remarks                                                                                                               |
|------|--------------|---------------------------------------|-------------|---------------------------------------------|------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| 1    | 145-07000-A  | ANALYTICAL INSTS.SAMPLE COOLER        | J001        | FORBES MARSHAL PVT. LTD.                    | REGULAR    | NA    | A-33/34, MIDC ESTATE, H-BLOCK, PIMPRI, PUNE-MAHARASHTRA-INDIA Phone- 27470171,27477472 Pincode : 411018 Email : nkaushal@forbesmarshall.com                                               | , ,                                                                                                                   |
| 2    | 145-07000-A  | ANALYTICAL INSTS.SAMPLE COOLER        | R002        | EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD. | REGULAR    | NA    | Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI-MAHARASHTRA-INDIA Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com       | , ,                                                                                                                   |
| 3    | 145-07000-A  | ANALYTICAL INSTS.SAMPLE COOLER        | S001        | SIEMENS LIMITED                             | REGULAR    | NA    | Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai-Maharashtra-INDIA Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com                        | , ,                                                                                                                   |
| 4    | 145-23000-A  | ANUBAR ( DELTA TUBE)                  | S009        | SWITZER PROCESS INSTRUMENTS PVT. LTD.       | REGULAR    | NA    | B Kannan/V S Jayaprakash 9, SOUTH BOAG ROAD, II FLOOR, PB NO-1423, T.NAGAR, CHENNAI-TAMIL NADU-INDIA Phone- 044-24340999 / 24344 Pincode : 600017 Email : marketing@switzerinstrument.com | Name changed from "M/s Switzer Instrument Ltd." to "M/s Switzer Process Instruments Pvt. Ltd." w.e.f. 27.07.2016; , , |
| 5    | 145-23000-A  | ANUBAR ( DELTA TUBE)                  | S044        | STAR-MECH CONTROLS (I) PVT.LTD.             | REGULAR    | B     | SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE-MAHARASHTRA-INDIA Phone- 02026970450 Pincode : 411028 Email : marketing@star-mech.net                                     | , ,                                                                                                                   |
| 6    | 145-23000-A  | ANUBAR ( DELTA TUBE)                  | M009        | MICRO PRECISION PRODUCTS PVT. LTD.          | REGULAR    | NA    | K.P. CHANDHOK/ATUL CHANDHOK 4, LINK ROAD, FARIDABAD-HARYANA-INDIA Phone- 9810265688 Pincode : 121002 Email : nal@microa1.com                                                              | , ,                                                                                                                   |
| 7    | 145-23000-A  | ANUBAR ( DELTA TUBE)                  | D212        | DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD. | REGULAR    | NA    | Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum-karnataka-India Phone- 0831-4210386 Pincode : 590008 Email : yogish@dynafluid.com                                                     | , ,                                                                                                                   |
| 8    | 145-23000-A  | ANUBAR ( DELTA TUBE)                  | T108        | TM TECNOMATIC SPA                           | REGULAR    | NA    | MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzoc VIA DELLE INDUSTRIE, 36 CREMONA-ITALY Phone- 39037221574 Pincode : 26100 Email : info@tmtcnomatic.com                                             | , ,                                                                                                                   |
| 9    | 145-31000-A  | Cold Junction Compensation Box (CJCB) | C048        | CREATIVE INSTRUMENTS & CONTROLS             | REGULAR    | B     | NO-17/1, 1ST FLOOR, 11TH CROSS 1ST K BLOCK, RAJAJINAGAR, BANGALORE-560010 -- Phone- Pincode : Email : crinstruments@gmail.com                                                             | , ,                                                                                                                   |

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|----|-------------|---------------|------|--------------------------------------------|---------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10 | 145-04000-A | CONTROL VALVE | C010 | SPX Flow Technology (I) Pvt. Ltd.          | REGULAR | NA | Survey No 275, Odhav Road, Odhav Ahmedabad-Gujarat-India Phone- +91 (0) 8939963099 Pincode : 382415 Email : siva.prakash@spx.com                                                    | Name changed from M/s DeZURIK-Copes Vulcan Ltd. to M/s SPX Corporation, USA as per 25th MISCC-Electrical and C&I dtd. 20.02.2014; Put on HOLD for 6 months w.e.f. 18.05.2012 & uplifted on 19.03.2014.; , POs to be placed on Indian subs.M/s SPX Flow Technology (I) Pvt. Ltd., Ahmedabad, India and the material will be supplied as per scope matrix[Available at CMM-->VD DOCUMENTS-->SCOPE |
| 11 | 145-04000-A | CONTROL VALVE | D027 | DRESSER VALVE INDIA PVT. LTD               | REGULAR | NA | Mr. Raj Raman/Mr. Rajkumar Moria S.F. No: 608,Chettipalayam Road, Echanari Post, Coimbatore-Tamilnadu-INDIA Phone- +91-98451 19085 Pincode : 641021 Email : Anoop.Ramachandran@ge.c | , ,                                                                                                                                                                                                                                                                                                                                                                                             |
| 12 | 145-04000-A | CONTROL VALVE | D057 | Daume Regelarmaturen GmbH,                 | REGULAR | NA | Mr. Björn Carstensen Am Springbrunnen 23, Barleben--Germany, Phone- 9820805424, Pincode : 39179 Email : madhu@aumvn.com, info@daume-regelarmaturen.de,                              | GCC R.5 accepted by vendor. , Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry;                                                                                                                                                                                                                                                                                |
| 13 | 145-04000-A | CONTROL VALVE | F015 | EMERSON PROCESS MANAGEMENT CHENNAI LIMITED | REGULAR | C  | 147, KARAPAKKAM VILLAGE, CHENNAI-TAMIL NADU-INDIA Phone- 23722184, 23716242 Pincode : 600096 Email : jatinder.singh@emerson.com                                                     | Vendor's name changed from "Fisher Sanmar Limited" to "Emerson Process Management Chennai Limited" w.e.f. 22.09.2011 , ,                                                                                                                                                                                                                                                                        |
| 14 | 145-04000-A | CONTROL VALVE | F030 | FORBES MARSHALL ARCA PVT.LTD.              | REGULAR | NA | A-34/35 , MIDC ESTATE, H-BLOCK, PIMPRI, PUNE,- MAHARASTRA-INDIA, Phone- 020-27442020, Pincode : 411018 Email : mnadgaundi@forbesmarshall.com                                        | , Technical limit reviewed on 30.04.2014 and further revised on 29.12.2015; , Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry;                                                                                                                                                                                                                                |
| 15 | 145-04000-A | CONTROL VALVE | H057 | HOLTER REGELARMATUREN GmbH & Co.KG         | REGULAR | NA | HOLTER REGELARMATUREN GmbH & Co.KG , Helleforthstrasse 58-60, D 33758 Schloss Holte-Stukenbrock Germany-- Phone- 0049-05207/88037 Pincode : Email : mail@hora.de                    | , HOLD due to non-responss /non-participation w.e.f. 31.01.2013; Hold removed w.e.f. 16.10.2014.                                                                                                                                                                                                                                                                                                |

|    |                        |               |      |                                                    |         |    |                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                              |
|----|------------------------|---------------|------|----------------------------------------------------|---------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16 | 145-04000-A            | CONTROL VALVE | K048 | Koso India Private Limited,                        | REGULAR | A  | H 33 & 34, MIDC, Ambad, Nashik,-Maharashtra,-India, Phone- 91 944 744 3198 Pincode : 422010, Email : seemaanand_sa@koso.co.in                                                   | , The name has been changed from M/s KOSO FLUID CONTROLS (PVT) LTD to M/s Koso India Private Limited as per 11th MISCC Elect and C&I dated 30.07.2013. , Approved works at Control Valve Division, H-33&34, Ambad, Nashik w.e.f. 12.10.2015; Additional works at "J-1,MIDC,Ambad, nashik-422010" approved w.e.f. 17.06.2016; |
| 17 | <del>145-04000-A</del> | CONTROL VALVE | M005 | MIL CONTROLS LTD.                                  | REGULAR | B  | Mr.Jacob Cherian/Mr.Geo Jolly Meladoor, Annamanada P.O. MALA, Thrissur-KERALA INDIA Phone- 0480-2695700 Pincode : 680741 Email : biju.simon@ksb.com                             | , ,                                                                                                                                                                                                                                                                                                                          |
| 18 | <del>145-04000-A</del> | CONTROL VALVE | I006 | INSTRUMENTATION LTD.                               | REGULAR | B  | KANJIKODE WEST, PALAKKAD, PALAKKAD-KERALA-INDIA Phone- 2566127-130,2567128 Pincode : <del>670623</del> Email : icvldil@gmail.com;fa2@ilpgt.com                                  | SICK PSU. BIFR CASE. , ,                                                                                                                                                                                                                                                                                                     |
| 19 | 145-04000-A            | CONTROL VALVE | P203 | PARCOL S.p.A                                       | REGULAR | NA | Mr. Erminio Campanelli, Via Isonzo, 2, Canegrate MI--Italy Phone- 0349-7417774 Pincode : 200010 Email : mazurizio.para@parcol.com                                               | Indian Representative-M/s Astrotech, 35, MV Compound, Bridge Way Colony, Tiruppur - 641607, Tamil Nadu, India, Ph. No.-+91 975 199 4989; Email- mani@astrotech india.in , ,                                                                                                                                                  |
| 20 | 145-04000-A            | CONTROL VALVE | R001 | R.K.CONTROL INSTRUMENTS PVT. LTD.                  | REGULAR | NA | PLOT NO.A-250, OPP.POLICE STATION, WAGLE INDUSTRIAL ESTATE, THANE-MAHARASHTRA-INDIA Phone- 25820943/2331 Pincode : 400604 Email : rkcipl@vsnl.com ; rkcinpvt@bol.net.in         | HOLD due to non-responsse /non-participation w.e.f. 10.01.2013.HOLD due to non-responsse /non-participation w.e.f. 01.02.2013.Hold is lifted w.e.f. 21.09.2013. , Reassessed on 26.02.2016; Technical limit added w.e.f. 26.02.2016; ,                                                                                       |
| 21 | 145-04000-A            | CONTROL VALVE | S237 | SUZHOU DELAN ENERGY SCIENCE & TECHNOLOGY CO., LTD. | REGULAR | NA | No 566 Fangqiao Road Caohu Industrial Park, Xiangcheng Economic Development Zone, Suzhou-Jiangsu-China Phone- 008618012776062 Pincode : 215143 Email : huanlele@delan-valve.com | , ,                                                                                                                                                                                                                                                                                                                          |

|    |             |                            |      |                                     |         |    |                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                |
|----|-------------|----------------------------|------|-------------------------------------|---------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22 | 145-04000-A | CONTROL VALVE              | V051 | Valvitalia S.P.A. ,                 | REGULAR | NA | Mr. Salvatore Ruggeri Via Tortona 69, Rivanazzano (Pavia) --Italy, Phone- +39-03839459875 Pincode : 27055 Email : gianluca.angeleri@valvitalia.com       | One Time Code accorded for "Control Valves" package for "1x500 MW Vindhyaachal STPP Stage-V" project. , Supplier registered in permanent category as per 28th MISCC-Electrical and C&I dtd. 31.03.2014 , Deleted due to non-response in 4 consecutive tenders w.e.f. 27.07.2016; Decision revoked as per MISCC dt. 05.08.2016; |
| 23 | 145-04000-A | CONTROL VALVE              | W202 | WALDEMAR PRUSS ARMATURENFABRIK GMBH | REGULAR | NA | Mr. Winfried Dremhel Schulenburgerlandstrasse 261, Hannover--Germany Phone- +49-511279260 Pincode : 30419 Email : dremhel@pruss.de; vogel@pruss.de       | Indian Representative- M/s H S Engineering & Marketing Services, B2/73C Safdarjung Enclave, New Delhi - 110029, Ph No.-011-26193156/9313 007463; Email- joy@hsgroupdelhi.com , ,                                                                                                                                               |
| 24 | 145-47000-A | ELECTROMAGNETIC FLOW METER | E211 | Electronet Equipments Pvt Ltd.      | REGULAR | NA | Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune-Maharashtra-India Phone- 020-2026932039 Pincode : 411048 Email : ho@eenindia.com       | , ,                                                                                                                                                                                                                                                                                                                            |
| 25 | 145-47000-A | ELECTROMAGNETIC FLOW METER | A216 | Adept Fluidyne Pvt. Ltd.            | REGULAR | NA | Vinayak Gadre Plot No 4,S.No.17/1-B Kothrud Industrial Estate Pune-Maharashtra-India Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com | , ,                                                                                                                                                                                                                                                                                                                            |
| 26 | 145-12000-A | FLOW ELEMENT               | S044 | STAR-MECH CONTROLS (I) PVT.LTD.     | REGULAR | C  | SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE- MAHARASHTRA-INDIA Phone- 02026970450 Pincode : 411028 Email : modulation@star-mech.net  | , ,                                                                                                                                                                                                                                                                                                                            |
| 27 | 145-12000-A | FLOW ELEMENT               | I006 | INSTRUMENTATION LTD.                | REGULAR | C  | KANJIKODE WEST, PALAKKAD, PALAKKAD-KERALA-INDIA Phone- 2566127-130,2567128 Pincode : 678623 Email : icvdlil@gmail.com;fa2@ilpgt.com                      | SICK PSU. BIFR CASE. , ,                                                                                                                                                                                                                                                                                                       |
| 28 | 145-12000-A | FLOW ELEMENT               | M009 | MICRO PRECISION PRODUCTS PVT. LTD.  | REGULAR | C  | K.P. CHANDHOK/ATUL CHANDHOK 4, LINK ROAD, FARIDABAD-HARYANA-INDIA Phone- 9810265688 Pincode : 121002 Email : nal@micro1.com                              | REGISTERED AS MSED VENDOR W.E.F.15.11.20 11 FOR FY 2011-12. , ,                                                                                                                                                                                                                                                                |
| 29 | 145-12000-A | FLOW ELEMENT               | T108 | TM TECNOMATIC SPA                   | REGULAR | NA | MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzoc VIA DELLE INDUSTRIE, 36 CREMONA-ITALY Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com           | , ,                                                                                                                                                                                                                                                                                                                            |

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|----|------------------------|------------------------|------|---------------------------------------------|---------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 30 | <del>145-44000-A</del> | FLOW ELEMENT - NOZZLE  | S165 | SEIKO FLOW CONTROL GMBH                     | REGULAR | NA | Mr. Friedrich Rupprecht/ Mr. S. Subhash Zur Schleuse 5, 2000 Stockerau, Stockerau--Austria Phone- 9811047972 Pincode : Email : office@seiko-flowcontrol.com                                  | Indian Representative: M/s Menon Associates, 118, Aurobindo Commercial Complex, New Delhi-110016 |
| 31 | <del>145-44000-A</del> | FLOW ELEMENT - NOZZLE  | I006 | INSTRUMENTATION LTD.                        | REGULAR | B  | KANJIKODE WEST, PALAKKAD, PALAKKAD-KERALA-INDIA Phone- 2566127-130,2567128 Pincode : 678623 Email : icvdiil@gmail.com,raz@vgt.com                                                            | SICK PSU. BIFR CASE. , ,                                                                         |
| 32 | <del>145-44000-A</del> | FLOW ELEMENT - NOZZLE  | M009 | MICRO PRECISION PRODUCTS PVT. LTD.          | REGULAR | B  | K.P. CHANDHOK/ATUL CHANDHOK 4, LINK ROAD, FARIDABAD-HARYANA-INDIA Phone- 9810265688 Pincode : 121002 Email : nal@micro1.com                                                                  | REGISTERED AS MSMD VENDOR W.E.F.15.11.2011 FOR FY 2011-12. , ,                                   |
| 33 | 145-44000-A            | FLOW ELEMENT - NOZZLE  | M201 | MINCO (INDIA) FLOW ELEMENTS PVT. LTD.       | REGULAR | NA | Mr. Raghavendra M. Kulkarni D2-49/50, Tivim Industrial Estate, Karaswada Mapusa-Goa-India Phone- 0832-2257059 Pincode : 403526 Email : gicflowelement@giconindia.com                         | , ,                                                                                              |
| 34 | <del>145-44000-A</del> | FLOW ELEMENT - NOZZLE  | S044 | STAR-MECH CONTROLS (I) PVT.LTD.             | REGULAR | B  | SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE-MAHARASHTRA-INDIA Phone- 02026970450 Pincode : 411028 Email : madkoting@star-mech.net                                        | , ,                                                                                              |
| 35 | 145-44000-A            | FLOW ELEMENT - NOZZLE  | D212 | DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD. | REGULAR | NA | Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum-karnataka-India Phone- 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com                                                       | , ,                                                                                              |
| 36 | <del>145-44000-A</del> | FLOW ELEMENT - NOZZLE  | H066 | HYDROPNEUMATICS PVT. LTD.                   | REGULAR | NA | Mr. DM Bichu G/B, Hill Crown Apts., College Road Mapusa-Goa-India Phone- 0832-2360364 Pincode : 403507 Email : ajayrc@hydropneumatics.co.in                                                  | , ,                                                                                              |
| 37 | 145-43000-A            | FLOW ELEMENT - ORIFICE | H066 | HYDROPNEUMATICS PVT. LTD.                   | REGULAR | NA | Mr. DM Bichu G/B, Hill Crown Apts., College Road Mapusa-Goa-India Phone- 0832-2360364 Pincode : 403507 Email : ajayrc@hydropneumatics.co.in                                                  | , ,                                                                                              |
| 38 | <del>145-43000-A</del> | FLOW ELEMENT - ORIFICE | F033 | Flow Star Engineering Pvt. Ltd.,            | REGULAR | A1 | MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No- 7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD-HARYANA-INDIA Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in | , ,                                                                                              |
| 39 | 145-43000-A            | FLOW ELEMENT - ORIFICE | D212 | DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD. | REGULAR | NA | Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum-karnataka-India Phone- 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com                                                       | , ,                                                                                              |
| 40 | <del>145-43000-A</del> | FLOW ELEMENT - ORIFICE | S044 | STAR-MECH CONTROLS (I) PVT.LTD.             | REGULAR | B  | SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE-MAHARASHTRA-INDIA Phone- 02026970450 Pincode : 411028 Email : madkoting@star-mech.net                                        | , ,                                                                                              |
| 41 | <del>145-43000-A</del> | FLOW ELEMENT - ORIFICE | M009 | MICRO PRECISION PRODUCTS PVT. LTD.          | REGULAR | B  | K.P. CHANDHOK/ATUL CHANDHOK 4, LINK ROAD, FARIDABAD-HARYANA-INDIA Phone- 9810265688 Pincode : 121002 Email : nal@micro1.com                                                                  | REGISTERED AS MSMD VENDOR W.E.F.15.11.2011 FOR FY 2011-12. , ,                                   |

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| 42 | 145-43000-A            | <del>FLOW ELEMENT - ORIFICE</del> | I006            | INSTRUMENTATION LTD.                              | REGULAR            | NA           | KANJIKODE WEST, PALAKKAD, PALAKKAD-KERALA-INDIA Phone- 2566127-130,2567128 Pincode : 678623 Email : icvdlil@gmail.com;fa2@ilpgt.com                                                                                        | SICK PSU. BIFR CASE. , ,                                                    |
| 43 | <del>145-43000-A</del> | <del>FLOW ELEMENT - ORIFICE</del> | <del>I030</del> | <del>INSTRUMENTATION ENGINEERS PVT LTD</del>      | <del>REGULAR</del> | <del>B</del> | <del>SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD-TELANGANA-INDIA Phone- 9848407365 Pincode : 500055 Email : jeeedimetla@jeedimetla.com</del>                                         | <del>, ,</del>                                                              |
| 44 | 145-45000-A            | INSTRUMENT FITTINGS               | P046            | PRECISION ENGINEERING INDUSTRIES                  | REGULAR            | NA           | K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com                                                          | , ,                                                                         |
| 45 | 145-45000-A            | INSTRUMENT FITTINGS               | P082            | PANAM ENGINEERS                                   | REGULAR            | NA           | Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,-India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,                                        | , ,                                                                         |
| 46 | 145-45000-A            | INSTRUMENT FITTINGS               | P81             | Perfect Instrumentation Control (India) Pvt. Ltd. | REGULAR            | NA           | MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai-Maharashtra-INDIA Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com | , ,                                                                         |
| 47 | 145-45000-A            | INSTRUMENT FITTINGS               | C067            | Comfit & Valve Pvt. Ltd.                          | REGULAR            | NA           | Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan-Gujarat-INDIA Phone- 02764-267036/37 Pincode : 382705 Email : jeetukojia@com-fit.com                                  | , ,                                                                         |
| 48 | 145-45000-A            | INSTRUMENT FITTINGS               | A079            | AURA INCORPORATED                                 | REGULAR            | NA           | NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com                                                                                     | , ,                                                                         |
| 49 | 145-45000-A            | INSTRUMENT FITTINGS               | A121            | Arya Crafts & Engineering Pvt. Ltd.               | REGULAR            | NA           | Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai-Maharashtra-INDIA Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com                        | , ,                                                                         |
| 50 | 145-45000-A            | INSTRUMENT FITTINGS               | F040            | FLUIDFIT ENGINEERS PVT. LTD.                      | REGULAR            | NA           | Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai-Maharashtra-India Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com                                        | Registered as per 22nd Electrical and C&I MISCC Meeting dtd. 15.01.2014 , , |
| 51 | 145-45000-A            | INSTRUMENT FITTINGS               | H61             | HP VALVES & FITTINGS INDIA PVT. LTD.              | REGULAR            | C            | S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI-Tamilnadu-INDIA Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com                                                                 | , ,                                                                         |

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| 52 | 145-45000-A | INSTRUMENT FITTINGS       | H024 | Fluid Controls Pvt. Ltd.         | REGULAR | NA | Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com | Name changed from M/s Hyd-Air Valves Pvt. Ltd. to M/s Fluid Controls Pvt. Ltd. as per 25th MISCC-Electrical and C&I dtd. 20.02.2014 , , |
| 53 | 145-45000-A | INSTRUMENT FITTINGS       | V039 | VIKAS INDUSTRIAL PRODUCTS        | REGULAR | NA | S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com                                                           | , Financial limit reviewed on 05.06.2014 , ,                                                                                            |
| 54 | 145-38000-A | INSTRUMENTS PIPE FITTINGS | V039 | VIKAS INDUSTRIAL PRODUCTS        | REGULAR | A  | S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com                                                           | , ,                                                                                                                                     |
| 55 | 145-38000-A | INSTRUMENTS PIPE FITTINGS | H024 | Fluid Controls Pvt. Ltd.         | REGULAR | B  | Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com | , ,                                                                                                                                     |
| 56 | 145-38000-A | INSTRUMENTS PIPE FITTINGS | A079 | AURA INCORPORATED                | REGULAR | NA | NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : nirai@aurainc.com                                                            | , ,                                                                                                                                     |
| 57 | 145-38000-A | INSTRUMENTS PIPE FITTINGS | P046 | PRECISION ENGINEERING INDUSTRIES | REGULAR | NA | K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com                                 | , ,                                                                                                                                     |
| 58 | 145-32000-A | INSTRUMENTS TUBE FITTINGS | P046 | PRECISION ENGINEERING INDUSTRIES | REGULAR | C  | K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI-MAHARASHTRA-INDIA Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com                                 | , ,                                                                                                                                     |
| 59 | 145-32000-A | INSTRUMENTS TUBE FITTINGS | A079 | AURA INCORPORATED                | REGULAR | C  | NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI-DELHI-INDIA Phone- 9810182430 Pincode : 110048 Email : nirai@aurainc.com                                                            | , ,                                                                                                                                     |
| 60 | 145-32000-A | INSTRUMENTS TUBE FITTINGS | H024 | Fluid Controls Pvt. Ltd.         | REGULAR | B  | Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI-MAHARASHTRA-INDIA Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com | , ,                                                                                                                                     |
| 61 | 145-32000-A | INSTRUMENTS TUBE FITTINGS | V039 | VIKAS INDUSTRIAL PRODUCTS        | REGULAR | NA | S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA-UTTAR PRADESH-INDIA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com                                                           | , ,                                                                                                                                     |

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|----|-------------|-------------------------------|------|----------------------------------------|---------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 62 | 145-25000-A | JUNCTION BOX                  | S114 | Shrenik & Company,                     | REGULAR | NA | Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad-Gujarat-India Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@pustron.com     | Registered for FRP JB's AND METAL JB's. , Technical limit reviewed on 30.04.2014; ,                                                                                           |
| 63 | 145-25000-A | JUNCTION BOX                  | F201 | FLEXPRO ELECTRICALS PVT. LTD.          | REGULAR | NA | Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari-Gujarat-India Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com                                                 | Technical limit reviewed on 12.10.2015; , ,                                                                                                                                   |
| 64 | 145-25000-A | JUNCTION BOX                  | A101 | AJMERIA INDUSTRIAL & ENGINEERING WORKS | REGULAR | C  | JIGNESH MAHENDRA AJMERIA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI-MAHARASHTRA-INDIA Phone- 022 67973578 Pincode : 400 088 Email : ajmeria@ajmeria.net, jmajmeria@yahoo.com    | Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry; , APPROVED FOR GALVANIZED AND FRP JUNCTION BOXES; Technical limit reviewed on 30.04.2014 , |
| 65 | 145-25000-A | JUNCTION BOX                  | K043 | K.S.INSTRUMENTS PVT.LTD.               | REGULAR | A  | S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore-Karnataka-India Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net                                | , ,                                                                                                                                                                           |
| 66 | 145-25000-A | JUNCTION BOX                  | S095 | SUCHITRA INDUSTRIES                    | REGULAR | A  | NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE -- Phone- Pincode : Email : suchitra.industriesblr@gmail.com                                                                  | , ,                                                                                                                                                                           |
| 67 | 145-11000-A | LEVEL GAUGE                   | S008 | SIGMA INSTRUMENTS CO.                  | REGULAR | NA | Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI-MAHARASHTRA-INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.i | , ,                                                                                                                                                                           |
| 68 | 145-11000-A | LEVEL GAUGE                   | B077 | BLISS ANAND PVT. LTD.                  | REGULAR | NA | Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon-Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com                                                   | , ,                                                                                                                                                                           |
| 69 | 145-11000-A | LEVEL GAUGE                   | T001 | TOSHNIWAL BROTHERS PVT.LTD.            | REGULAR | NA | WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER-RAJASTHAN-INDIA Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com                                                   | , ,                                                                                                                                                                           |
| 70 | 145-35000-A | LEVEL SWITCH-CAPACITANCE TYPE | S123 | Sapcon Instrument Pvt Ltd.             | REGULAR | NA | 131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE-MP-INDIA Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.co                                           | , ,                                                                                                                                                                           |

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| 71 | 145-35000-A | LEVEL SWITCH-CAPACITANCE TYPE  | W017 | Baumer Technologies India Pvt. Ltd. | REGULAR | NA | Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com | , NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 10.06.2012 |
| 72 | 145-35000-A | LEVEL SWITCH-CAPACITANCE TYPE  | V040 | V. AUTOMAT & INSTRUMENTS (P) LTD.   | REGULAR | NA | Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com                                                          | , ,                                                                                                                   |
| 73 | 145-35000-A | LEVEL SWITCH-CAPACITANCE TYPE  | B077 | BLISS ANAND PVT. LTD.               | REGULAR | NA | Mr. Vikas Anand/Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon-Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com                                                            | , ,                                                                                                                   |
| 74 | 145-35000-A | LEVEL SWITCH-CAPACITANCE TYPE  | F033 | Flow Star Engineering Pvt. Ltd.,    | REGULAR | A1 | MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No- 7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD-HARYANA-INDIA Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in                | VENDOR IS REGISTERED IN MSEED (MICRO) W.E.F.30.11.2011 FOR FY 2011-12 , ,                                             |
| 75 | 145-35000-A | LEVEL SWITCH-CAPACITANCE TYPE  | S008 | SIGMA INSTRUMENTS CO.               | REGULAR | NA | Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI-MAHARASHTRA-INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.i         | , ,                                                                                                                   |
| 76 | 145-35000-A | LEVEL SWITCH-CAPACITANCE TYPE  | S010 | SOR INC.                            | REGULAR | NA | LARRY DEGARMO/Avdesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : ldegarmo@sorinc.com, avdesh@sherman-jedia.com                                             | , ,                                                                                                                   |
| 77 | 145-35000-A | LEVEL SWITCH-CAPACITANCE TYPE  | L005 | LEVCON INSTRUMENTS PVT. LTD.        | REGULAR | NA | Mr Shayak Gupta/Badal Jana Rajkamal, 7th floor, 13, Camac Street KOLKATA- WEST BENGAL-INDIA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com                                           | , ,                                                                                                                   |
| 78 | 145-35000-A | LEVEL SWITCH-CAPACITANCE TYPE  | P068 | Pune Techtrol Pvt. Ltd.             | REGULAR | NA | N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune-Maharashtra-INDIA Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com                                                                      | , ,                                                                                                                   |
| 79 | 145-35000-A | LEVEL SWITCH-CAPACITANCE TYPE  | N035 | NIVO CONTROLS PVT. LTD.             | REGULAR | NA | MR.PRAVEEN TOSHNIWAL/MR. NITIN TAMHANE 104-115, ELECTRONIC COMPLEX, INDORE-MAHARASHTRA-INDIA Phone- 07314081300 Pincode : 452010 Email : sales@nivocontrols.com                                             | , ,                                                                                                                   |
| 80 | 145-36000-A | LEVEL SWITCH-CONDUCTIVITY TYPE | L005 | LEVCON INSTRUMENTS PVT. LTD.        | REGULAR | NA | Mr Shayak Gupta/Badal Jana Rajkamal, 7th floor, 13, Camac Street KOLKATA- WEST BENGAL-INDIA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com                                           | , ,                                                                                                                   |

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|    |             |                                    |      |                                     |         |    |                                                                                                                                                                                                             |                                                                                                                       |
|----|-------------|------------------------------------|------|-------------------------------------|---------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| 81 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | S010 | SOR INC.                            | REGULAR | NA | LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com                                           | , ,                                                                                                                   |
| 82 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | S008 | SIGMA INSTRUMENTS CO.               | REGULAR | NA | Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI-MAHARASHTRA-INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.i         | , ,                                                                                                                   |
| 83 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | R047 | RAMAN INSTRUMENTS PVT.LTD.          | REGULAR | NA | Mr. N R Shenoy/Mr G B Vijh 8, First Floor.Plot : 160A Bait-Ush-Sharaf, 29th Road,Bandra(W) MUMBAI-Maharashtra-India Phone- 09892331381 Pincode : 400050 Email : ramanbhai@usol.com                          | Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014; ,                                   |
| 84 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | H047 | HI-TECH SYSTEMS & SERVICES LTD.     | REGULAR | NA | Mr. Vikash Agrawal/Mr. Tarun Debnath 119, PARK STREET , KOLKATA-West Bengal-India Phone- 033-22290045 Pincode : 700016 Email : saadatan@hitach.in                                                           | Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014; ,                                   |
| 85 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | B077 | BLISS ANAND PVT. LTD.               | REGULAR | NA | Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon-Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : caloc@blissanand.com                                                           | , ,                                                                                                                   |
| 86 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | V040 | V. AUTOMAT & INSTRUMENTS (P) LTD.   | REGULAR | NA | Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : caloc@vautomat.com                                                          | , ,                                                                                                                   |
| 87 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | S123 | Sapcon Instrument Pvt Ltd.          | REGULAR | NA | 131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE-MP-INDIA Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.co                                                   | , ,                                                                                                                   |
| 88 | 145-37000-A | LEVEL SWITCH-FLOAT TYPE            | V040 | V. AUTOMAT & INSTRUMENTS (P) LTD.   | REGULAR | NA | Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : caloc@vautomat.com                                                          | , ,                                                                                                                   |
| 89 | 145-37000-A | LEVEL SWITCH-FLOAT TYPE            | W017 | Baumer Technologies India Pvt. Ltd. | REGULAR | NA | Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com | , NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 12.05.2013 |
| 90 | 145-37000-A | LEVEL SWITCH-FLOAT TYPE            | B077 | BLISS ANAND PVT. LTD.               | REGULAR | NA | Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon-Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : caloc@blissanand.com                                                           | , ,                                                                                                                   |
| 91 | 145-37000-A | LEVEL SWITCH-FLOAT TYPE            | D046 | D.K. INSTRUMENTS PVT.LTD.           | REGULAR | NA | N.SIKDAR/ SUMIT SIKDAR 76/2,SELIMPUR RD DHAKURIA Kolkata-West Bengal-India Phone- 033-2415-1310. Pincode : 700031 Email : dkinst@usol.net                                                                   | , ,                                                                                                                   |

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| 81 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | S010 | SOR INC.                            | REGULAR | NA | LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com                                           | , ,                                                                                                                   |
| 82 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | S008 | SIGMA INSTRUMENTS CO.               | REGULAR | NA | Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI-MAHARASHTRA-INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.i         | , ,                                                                                                                   |
| 83 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | R047 | RAMAN INSTRUMENTS PVT.LTD.          | REGULAR | NA | Mr. N R Shenoy/Mr G B Vijh 8, First Floor.Plot : 160A Bait-Ush-Sharaf, 29th Road,Bandra(W) MUMBAI-Maharashtra-India Phone- 09892331381 Pincode : 400050 Email : ramanbhai@usol.com                          | Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014; ,                                   |
| 84 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | H047 | HI-TECH SYSTEMS & SERVICES LTD.     | REGULAR | NA | Mr. Vikash Agrawal/Mr. Tarun Debnath 119, PARK STREET , KOLKATA-West Bengal-India Phone- 033-22290045 Pincode : 700016 Email : saadnan@hitech.in                                                            | Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014; ,                                   |
| 85 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | B077 | BLISS ANAND PVT. LTD.               | REGULAR | NA | Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon-Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com                                                           | , ,                                                                                                                   |
| 86 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | V040 | V. AUTOMAT & INSTRUMENTS (P) LTD.   | REGULAR | NA | Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com                                                          | , ,                                                                                                                   |
| 87 | 145-36000-A | LEVEL SWITCH-<br>CONDUCTIVITY TYPE | S123 | Sapcon Instrument Pvt Ltd.          | REGULAR | NA | 131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE-MP-INDIA Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.co                                                   | , ,                                                                                                                   |
| 88 | 145-37000-A | LEVEL SWITCH-FLOAT TYPE            | V040 | V. AUTOMAT & INSTRUMENTS (P) LTD.   | REGULAR | NA | Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com                                                          | , ,                                                                                                                   |
| 89 | 145-37000-A | LEVEL SWITCH-FLOAT TYPE            | W017 | Baumer Technologies India Pvt. Ltd. | REGULAR | NA | Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com | , NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 12.05.2013 |
| 90 | 145-37000-A | LEVEL SWITCH-FLOAT TYPE            | B077 | BLISS ANAND PVT. LTD.               | REGULAR | NA | Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon-Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com                                                           | , ,                                                                                                                   |
| 91 | 145-37000-A | LEVEL SWITCH-FLOAT TYPE            | D046 | D.K. INSTRUMENTS PVT.LTD.           | REGULAR | NA | N.SIKDAR/ SUMIT SIKDAR 76/2,SELIMPUR RD DHAKURIA Kolkata-West Bengal-India Phone- 033-2415-1310. Pincode : 700031 Email : dkiest@usol.net                                                                   | , ,                                                                                                                   |

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| 92  | 145-37000-A | LEVEL SWITCH-FLOAT TYPE                | G060 | GENERAL INSTRUMENTS CONSORTIUM             | REGULAR | NA | Mr. Amarendra Kulkarni<br>194/195, Gopi Tank Road,<br>Off. Pandurang Naik Marg,<br>Mahim Mumbai-Maharashtra<br>India Phone- 9323195251<br>Pincode : 400016 Email :<br>amarendra@general-<br>gauges.com                               | Workas at-<br>GAUGES<br>BOURDON<br>INDIA PVT.<br>LTD. (A MFG.<br>UNIT OF<br>GENERAL<br>INSTRUMENTS<br>CONSORTIUM ,<br>PLOT NO-4, 5 &<br>6, JAWAHAR<br>Co-op.<br>INDUSTRIAL<br>ESTATE,<br>KAMOTHE,<br>PANVEL- 410<br>209 , , |
| 93  | 145-37000-A | LEVEL SWITCH-FLOAT TYPE                | S008 | SIGMA INSTRUMENTS CO.                      | REGULAR | C  | Gopal Kannan/R Gopinath<br>201, ANANDRAJ<br>INDUSTRIAL ESTATE,<br>OFF.LBS MARG, SONAPUR<br>LANE, BHANDUP (W)<br>MUMBAI-MAHARASHTRA-<br>INDIA Phone-<br>+919821038162 Pincode :<br>400078 Email :<br>sales@sigmainstruments.co.i<br>n | Vendor shall<br>source import<br>contents of<br>Level Switch<br>(Conductivity<br>Type) from<br>Mobrey<br>Measurement,<br>an operating<br>unit of Morbey<br>Ltd., Slough,<br>Berkshire,<br>United                            |
| 94  | 145-37000-A | LEVEL SWITCH-FLOAT TYPE                | S010 | SOR INC.                                   | REGULAR | NA | LARRY DEGARMO/Avdesh<br>Chandra, 14685 W. 105TH<br>STREET LENEXA-KANSAS-<br>USA Phone- 09810905139,<br>Pincode : 66215 Email :<br>Ldegarmo@sorinc.com,<br>avdesh@sherman-<br>india.com                                               | , ,                                                                                                                                                                                                                         |
| 95  | 145-37000-A | LEVEL SWITCH-FLOAT TYPE                | S106 | SBEM PVT. LTD.                             | REGULAR | NA | MR.N.K. BEDARKAR/MR.<br>VISHWANATH KARANDIK<br>39, ELECTRONIC CO.OP.<br>ESTATE, PUNE SATARA<br>ROAD PUNE,-<br>MAHARASHTRA-INDIA<br>Phone- 912041030100<br>Pincode : 411009 Email :<br>sawdalkhi@sbem.co.in                           | , ,                                                                                                                                                                                                                         |
| 96  | 145-37000-A | LEVEL SWITCH-FLOAT TYPE                | L005 | LEVCON INSTRUMENTS<br>PVT. LTD.            | REGULAR | NA | Mr Shayak Gupta/Badal Jana<br>Rajkamal, 7th floor, 13,<br>Camac Street KOLKATA-<br>WEST BENGAL-INDIA Phone-<br>0 33 2283 2766 Pincode :<br>700017 Email :<br>b_jana@levcongroup.com                                                  | , ,                                                                                                                                                                                                                         |
| 97  | 145-37000-A | LEVEL SWITCH-FLOAT TYPE                | P068 | Pune Techtrol Pvt. Ltd.                    | REGULAR | NA | N.P.Khatan/Sudhakar<br>Badiger S-18, MIDC Bhosari,<br>Pune-Maharashtra-INDIA<br>Phone- 9850560042 Pincode<br>: 411 026 Email :<br>ho@punetechtrol.com                                                                                | , ,                                                                                                                                                                                                                         |
| 98  | 145-08000-A | PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | F016 | FORBES MARSHALL<br>(HYD) LTD.              | REGULAR | NA | MR SATEESH PATALAY/MR.<br>M K SRINIVASAN PLOT NO.A-<br>19/2, & T-4/2, IDA,<br>NACHARAM, HYDERABAD-<br>TELANGANA-INDIA Phone-<br>9849913704 Pincode : 500<br>076 Email :<br>mksrinivasan@forbesmarshall<br>com                        | , ,                                                                                                                                                                                                                         |
| 99  | 145-08000-A | PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | H040 | H.GURU INSTRUMENTS<br>(SOUTH INDIA) P. LTD | REGULAR | B  | 32,INDUSTRIAL SUBURB<br>YESWANTHAPUR<br>BANGALORE-KARNATAKA-<br>www.hgurusouth.com Phone-<br>080-23370300, Pincode :<br>560022 Email :<br>info@hgurusouth.com                                                                        | , ,                                                                                                                                                                                                                         |
| 100 | 145-08000-A | PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | H023 | H.GURU INDUSTRIES                          | REGULAR | NA | Mr. G. D. Hazra/Mr. P. K.<br>Mitra 10 B, HO-CHI-MINH<br>SARANI, KOLKATA-WEST<br>BENGAL-INDIA Phone- 033<br>2282 2463 / 1637 Pincode :<br>700071 Email :<br>mguru@vscpl.net                                                           | , Financial limit<br>reviewed on<br>05.06.2014; ,                                                                                                                                                                           |

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| 101 | 145-08000-A | PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE   | G071 | GAUGE BOURDON INDIA<br>PVT. LTD.       | REGULAR | NA | 194/195, Gopi Tank Road,<br>Off Pandurang Naik Marg,<br>Mahim Mumbai,-<br>Maharashtra,-India, Phone-<br>011-41607463, Pincode :<br>400016, Email :<br>gicdelhi@general-<br>gauge.com                                                | Registered as<br>per 26th MISCC-<br>Electrical and<br>C&I dtd.<br>06.03.2014. , ,                                                                                                                                                                                                                          |
| 102 | 145-08000-A | PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE   | B083 | BOSE PANDA<br>INSTRUMENTS PVT.LTD.     | REGULAR | NA | Mr. Partha Bose 44, Saheed<br>Hemanta Kumar Bose,<br>Sarani, Kolkata-West Bengal<br>India Phone- +91 33 2548<br>7220 Pincode : 700074<br>Email :<br>parthabosebpi@gmail.com;<br>bosepanda@vsnl.net                                  | Trial to Hold as<br>per SEARP amd-<br>3,w.e.f. 15-09-<br>12 , Supplier<br>registered in<br>trial category on<br>30.10.2010 and<br>was thereafter<br>put in susp-hold<br>category as per<br>SEARP Amd-03<br>on 15.09.2012.<br>Further, on<br>evaluation put<br>in permanent<br>category on<br>20.08.2014; , |
| 103 | 145-08000-A | PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE   | A126 | PRECISION MASS<br>PRODUCTS PVT. LTD.   | REGULAR | NA | Mr. Nishit Patel/Mr. Anuj<br>Verma Plot No.2306, Phase<br>II, GIDC Chhatral Kalol-<br>Gujarat,-INDIA Phone-<br>9999464663 Pincode :<br>382729 Email :<br>sales@precisionmass.com                                                    | Registration of<br>"M/s Ashcroft<br>India Pvt. Ltd."<br>substituted to<br>"M/s Precision<br>Mass Products<br>Pvt. Ltd." as per<br>MISCC dt.<br>15.02.2016<br>based on<br>"Termination<br>and business<br>transfer<br>agreement"<br>submitted by                                                            |
| 104 | 145-08000-A | PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE   | A010 | A.N. INSTRUMENTS PVT.<br>LTD.          | REGULAR | C  | MARKETING DIVISION, 5th<br>FLOOR, 59-B,<br>CHOWRINGHEE ROAD,<br>KOLKATA-WEST BENGAL-<br>INDIA Phone-<br>24757784,22472509 Pincode<br>: 700020 Email :<br>anidol@bol.net.in                                                          | , ,                                                                                                                                                                                                                                                                                                        |
| 105 | 145-08000-A | PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE   | W017 | Baumer Technologies<br>India Pvt. Ltd. | REGULAR | NA | Mr. Shyam Warilani/Mr. V<br>Suresh Babu 36, DAMJI<br>SHAMJI INDUSTRIAL<br>COMPLEX, OFF.-MAHAKALI<br>CAVES ROAD, ANDHERI(E)<br>MUMBAI-Maharashtra-INDIA<br>Phone- +91 99589 25151<br>Pincode : 400093 Email :<br>sales.in@baumer.com | , NAME HAS<br>BEEN CHANGED<br>FROM M/S<br>WAAREE<br>INSTRUMENTS<br>LTD. TO M/S<br>BAUMER<br>TECHNOLOGIES<br>INDIA PVT.<br>LTD. W.E.F.<br>15.06.2013.                                                                                                                                                       |
| 106 | 145-06000-A | PRESSURE SWITCH/DIFF.<br>PRESSURE SWITCH | A126 | PRECISION MASS<br>PRODUCTS PVT. LTD.   | REGULAR | NA | Mr. Nishit Patel/Mr. Anuj<br>Verma Plot No.2306, Phase<br>II, GIDC Chhatral Kalol-<br>Gujarat,-INDIA Phone-<br>9999464663 Pincode :<br>382729 Email :<br>sales@precisionmass.com                                                    | Registration of<br>"M/s Ashcroft<br>India Pvt. Ltd."<br>substituted to<br>"M/s Precision<br>Mass Products<br>Pvt. Ltd." as per<br>MISCC dt.<br>15.02.2016<br>based on<br>"Termination<br>and business<br>transfer<br>agreement"<br>submitted by                                                            |
| 107 | 145-06000-A | PRESSURE SWITCH/DIFF.<br>PRESSURE SWITCH | B085 | Barksdale GmbH,<br>Germany             | REGULAR | NA | Michael Weileder Dorn<br>Assenheimer, Strasse 27<br>Reichelsheim--Germany<br>Phone- +91-9999107840<br>Pincode : D-61203 Email :<br>msinoh@barksdale.de                                                                              | , ,                                                                                                                                                                                                                                                                                                        |

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| 108 | 145-06000-A | PRESSURE SWITCH/DIFF. PRESSURE SWITCH | D021 | DRESSER INDUSTRIES INC.               | REGULAR | NA | Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat-India Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com                            | , ,                                                                                                                                                                         |
| 109 | 145-06000-A | PRESSURE SWITCH/DIFF. PRESSURE SWITCH | D003 | INDFOS (INDIA) LIMITED                | REGULAR | NA | MR.L.C.VENKATRANGAN/MR. B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai-TamilNadu- INDIA Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com | , ,                                                                                                                                                                         |
| 110 | 145-06000-A | PRESSURE SWITCH/DIFF. PRESSURE SWITCH | G060 | GENERAL INSTRUMENTS CONSORTIUM        | REGULAR | C  | Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai-Maharashtra India Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com                 | Workas at- GAUGES BOURDON INDIA PVT. LTD. (A MFG. UNIT OF GENERAL INSTRUMENTS CONSORTIUM , PLOT NO-4, 5 & 6, JAWAHAR Co-op. INDUSTRIAL ESTATE, KAMOTHE, PANVEL- 410 209 , , |
| 111 | 145-06000-A | PRESSURE SWITCH/DIFF. PRESSURE SWITCH | K054 | Kaustubha Udyog,                      | REGULAR | NA | S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune,- Maharashtra,-India, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,                                               | , ,                                                                                                                                                                         |
| 112 | 145-06000-A | PRESSURE SWITCH/DIFF. PRESSURE SWITCH | I041 | INDFOS INDUSTRIES LIMITED             | REGULAR | C  | B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD-UP-INDIA Phone- 0120-2712016 Pincode : Email : mktn@indfos.com                                                                                  | , ,                                                                                                                                                                         |
| 113 | 145-06000-A | PRESSURE SWITCH/DIFF. PRESSURE SWITCH | S010 | SOR INC.                              | REGULAR | NA | LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS- USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com                               | , ,                                                                                                                                                                         |
| 114 | 145-06000-A | PRESSURE SWITCH/DIFF. PRESSURE SWITCH | S009 | SWITZER PROCESS INSTRUMENTS PVT. LTD. | REGULAR | C  | B Kannan/V S Jayaprakash 9, SOUTH BOAG ROAD, II FLOOR, PB NO-1423, T.NAGAR, CHENNAI-TAMIL NADU-INDIA Phone- 044-24340999 / 24344 Pincode : 600017 Email : marketing@switzerinstrument.com        | Name changed from "M/s Switzer Instrument Ltd." to "M/s Switzer Process Instruments Pvt. Ltd." w.e.f. 27.07.2016; , ,                                                       |
| 115 | 145-03000-A | PROGRAMMABLE LOGIC CONTROLLER         | R021 | ROCKWELL AUTOMATION INDIA LTD         | REGULAR | NA | (ALLENBRADLEY),C-11, SITE-4, INDUSTRIAL AREA SHHIBABAD, GHAZIABAD-UP-INDIA Phone- 2895247-52 Pincode : 201010 Email : pmehotra@rockwell.com                                                      | , ,                                                                                                                                                                         |
| 116 | 145-03000-A | PROGRAMMABLE LOGIC CONTROLLER         | S001 | SIEMENS LIMITED                       | REGULAR | NA | Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai-Maharashtra-INDIA Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com                               | , ,                                                                                                                                                                         |
| 117 | 145-03000-A | PROGRAMMABLE LOGIC CONTROLLER         | S083 | SCHNEIDER ELECTRIC INDIA PVT.LTD.     | REGULAR | NA | A-4, MOHAN CO-OP INDL AREA MATHURA ROAD NEW DELHI-DELHI-INDIA Phone- Pincode : 110044 Email : aditya.bawa@schneider-electric.com                                                                 | , ,                                                                                                                                                                         |

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| 118 | 145-03000-A | PROGRAMMABLE LOGIC CONTROLLER | M205 | mitsubishi electric india pvt. ltd.      | REGULAR | NA | Mr. Mehul Dholakia Emerald House, EL-3, J Block, M.I.D.C., Bhosari, Pune- Maharashtra-India Phone- 020-27102000 Pincode : 411026 Email : mehul.dholakia@asia.meap.com                                | , ,                                                                     |
| 119 | 145-03000-A | PROGRAMMABLE LOGIC CONTROLLER | H063 | Honeywell Automation India Limited ,     | REGULAR | NA | 56 & 57, Hadapsar Industrial Estate, Pune,- Maharashtra,-India, Phone- 9689940949, Pincode : Email : amit.aglave@honeywell.com,                                                                      | , ,                                                                     |
| 120 | 145-03000-A | PROGRAMMABLE LOGIC CONTROLLER | G035 | GE Intelligent Platforms Private Limited | REGULAR | B  | 90/B, ELECTRONICS CITY, HOSUR ROAD, BANGLORE-KARNATAKA-INDIA Phone- 28528328 Pincode : 561229 Email : shivesh.k.iba@ge.com                                                                           | , ,                                                                     |
| 121 | 145-34000-A | ROTAMETER                     | F033 | Flow Star Engineering Pvt. Ltd.,         | REGULAR | B  | MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No- 7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD-HARYANA- INDIA Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in        | VENDOR IS REGISTERED IN MS&D (MICRO) W.E.F.30.11.2011 FOR FY 2011-12, , |
| 122 | 145-34000-A | ROTAMETER                     | E047 | EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.    | REGULAR | NA | Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune-Maharashtra-India Phone- 9370469466 Pincode : 411038 Email : caloc@eurekaflow.com                                              | , ,                                                                     |
| 123 | 145-34000-A | ROTAMETER                     | I030 | INSTRUMENTATION ENGINEERS PVT LTD        | REGULAR | A  | SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD-TELANGANA-INDIA Phone- 9848407365 Pincode : 500055 Email : iad@nvl@flowmotors.com                                  | , ,                                                                     |
| 124 | 145-34000-A | ROTAMETER                     | S158 | SCIENTIFIC DEVICES (BOMBAY) PVT LTD,     | REGULAR | NA | Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai,-Maharashtra,- INDIA Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com                          | , ,                                                                     |
| 125 | 145-16000-A | SIGHT FLOW INDICATORS         | S158 | SCIENTIFIC DEVICES (BOMBAY) PVT LTD,     | REGULAR | NA | Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai,-Maharashtra,- INDIA Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com                          | , ,                                                                     |
| 126 | 145-16000-A | SIGHT FLOW INDICATORS         | I030 | INSTRUMENTATION ENGINEERS PVT LTD        | REGULAR | A  | SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD-TELANGANA-INDIA Phone- 9848407365 Pincode : 500055 Email : iad@nvl@flowmotors.com                                  | , ,                                                                     |
| 127 | 145-16000-A | SIGHT FLOW INDICATORS         | S008 | SIGMA INSTRUMENTS CO.                    | REGULAR | NA | Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI-MAHARASHTRA- INDIA Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.i | Reassessed on 27.04.2016; , ,                                           |
| 128 | 145-16000-A | SIGHT FLOW INDICATORS         | B077 | BLISS ANAND PVT. LTD.                    | REGULAR | NA | Mr. Vikas Anand/ Mr.RG Rajan 92B & 93 B , IMT MANESAR Gurgaon- Haryana-India Phone- 0124-4366000 TO 9 Pincode : 122001 Email : caloc@blissanand.com                                                  | Reassessed on 31.03.2016; , ,                                           |

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| 129 | <del>145-16000-A</del> | SIGHT FLOW INDICATORS | B068 | B.K.EQUIPMENTS PVT.LTD.                    | REGULAR | A1 | T. BALAKRISHNAN/S.VENKATES H 217 , ARCOT ROAD PORUR , CHENNAI-TAMIL NADU,INDIA Phone- 9444057761 Pincode : 600116 Email : bkravin@gmail.com                                                                 | , ,                                                                                                                   |
| 130 | 145-13000-A            | TEMP. ELEMENT         | G032 | GOA INSTRUMENTS INDUSTRIES PVT.LTD.,       | REGULAR | NA | D2/5, Mapusa Industrial Estate, Mapusa, Goa,- MAHARASHTRA-INDIA Phone- 09326054551, Pincode : 403507, Email : sumukh@goinstruments.com,                                                                     | GCC Rev.5 has been accepted in toto. , ,                                                                              |
| 131 | 145-13000-A            | TEMP. ELEMENT         | G071 | GAUGE BOURDON INDIA PVT. LTD.              | REGULAR | NA | 194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,- Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-avulac.com                                             | , ,                                                                                                                   |
| 132 | 145-13000-A            | TEMP. ELEMENT         | I022 | DETRIVE INSTRUMENTATION & ELECTRONICS LTD. | REGULAR | B  | 320, TV INDUSTIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI-MAHARASHTRA-INDIA Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com                                           | , ,                                                                                                                   |
| 133 | 145-13000-A            | TEMP. ELEMENT         | P061 | PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.     | REGULAR | B  | M. D. BICHU/R. M. BICHU G.B. HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA-GOA-INDIA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in                                           | , ,                                                                                                                   |
| 134 | 145-13000-A            | TEMP. ELEMENT         | T106 | TECHNO INSTRUMENTS                         | REGULAR | NA | Abhijit Gohel/Mr. Amit Pandya Plot No. 1145/1, Uma Convector Lane, Santej,Ta. Kalol, Gandhinagar-Gujarat-India Phone- 9909925223 Pincode : 382721 Email : amit@techno-instruments.com                       | , ,                                                                                                                   |
| 135 | 145-13000-A            | TEMP. ELEMENT         | T107 | Tempsens Instrument (I) Pvt Ltd            | REGULAR | NA | MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR-RAJASTHAN-INDIA Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com                                                               | , ,                                                                                                                   |
| 136 | 145-13000-A            | TEMP. ELEMENT         | T108 | TM TECNOMATIC SPA                          | REGULAR | NA | MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzoc VIA DELLE INDUSTRIE, 36 CREMONA-ITALY Phone- 39037221574 Pincode : 26100 Email : info@tmttecnomatic.com                                                             | , ,                                                                                                                   |
| 137 | 145-13000-A            | TEMP. ELEMENT         | T115 | Thermal Instrument India Pvt. Ltd.         | REGULAR | NA | Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema,Mahim Mumbai-Maharashtra-India Phone- 09322664709 Pincode : 400016 Email : ramk@aicoindia.com                                   | Registered as per 11th MISCC-Electrical and C&I (FY 2014-15) dt. 20.09.2014. , ,                                      |
| 138 | 145-13000-A            | TEMP. ELEMENT         | T111 | TOSHNIWAL INDUSTRIES PVT. LTD.,            | REGULAR | NA | Industrial Estate, Makhupura, Ajmer,- Rajasthan,-India, Phone- 9352009000, Pincode : 305002, Email : info@tinl.com                                                                                          | GCC Rev.5 has been accepted in toto. , ,                                                                              |
| 139 | 145-13000-A            | TEMP. ELEMENT         | W017 | Baumer Technologies India Pvt. Ltd.        | REGULAR | NA | Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com | , NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 12.06.2012 |

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| 140 | 145-10000-A | TEMPERATURE GAUGE | W017 | Baumer Technologies India Pvt. Ltd.     | REGULAR | C  | Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra-INDIA Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com | , NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 12.06.2012                                                                                 |
| 141 | 145-10000-A | TEMPERATURE GAUGE | G071 | GAUGE BOURDON INDIA PVT. LTD.           | REGULAR | NA | 194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Maharashtra,-India, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com                                              | , ,                                                                                                                                                                                                   |
| 142 | 145-10000-A | TEMPERATURE GAUGE | H023 | H.GURU INDUSTRIES                       | REGULAR | NA | Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA-WEST BENGAL-INDIA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : gaurur@hgsouth.net                                                 | , Financial limit reviewed on 05.06.2014; ,                                                                                                                                                           |
| 143 | 145-10000-A | TEMPERATURE GAUGE | H040 | H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD | REGULAR | B  | 32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE-KARNATAKA- www.hgurusouth.com Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com                                                                 | , ,                                                                                                                                                                                                   |
| 144 | 145-10000-A | TEMPERATURE GAUGE | G032 | GOA INSTRUMENTS INDUSTRIES PVT.LTD.,    | REGULAR | D  | D2/5, Mapusa Industrial Estate, Mapusa, Goa,- MAHARASHTRA-INDIA Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,                                                                    | GCC Rev.5 has been accepted in toto. , ,                                                                                                                                                              |
| 145 | 145-10000-A | TEMPERATURE GAUGE | G047 | GOA THERMOSTATIC INSTRUMENTS PVT.LTD.   | REGULAR | B  | FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA-GOA-INDIA Phone- Pincode : 403525 Email : nhilworks@mvno-electric.in                                                                                   | , ,                                                                                                                                                                                                   |
| 146 | 145-10000-A | TEMPERATURE GAUGE | F016 | FORBES MARSHALL (HYD) LTD.              | REGULAR | NA | MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-TELANGANA-INDIA Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com                         | , ,                                                                                                                                                                                                   |
| 147 | 145-10000-A | TEMPERATURE GAUGE | A126 | PRECISION MASS PRODUCTS PVT. LTD.       | REGULAR | NA | Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,-INDIA Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com                                               | Registration of "M/s Ashcroft India Pvt. Ltd." substituted to "M/s Precision Mass Products Pvt. Ltd." as per MISCC dt. 15.02.2016 based on "Termination and business transfer agreement" submitted by |
| 148 | 145-10000-A | TEMPERATURE GAUGE | B014 | BUDENBERG GUAGE CO.LTD.                 | REGULAR | NA | PO BOX-5, ALTRINCHAM CHESHIRE-UK-UK Phone- 0161-9285441 Pincode : WA14 4ER Email : dhhdelhi@vusol.net                                                                                                       | , ,                                                                                                                                                                                                   |
| 149 | 145-10000-A | TEMPERATURE GAUGE | A010 | A.N. INSTRUMENTS PVT. LTD.              | REGULAR | C  | MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL-INDIA Phone- 24757784,22472509 Pincode : 700020 Email : anidol@bol.net.in                                                        | , ,                                                                                                                                                                                                   |

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| 150 | 145-15000-A | TEMPERATURE SWITCH | D003 | INDFOS (INDIA) LIMITED                | REGULAR | NA | MR.L.C.VENKATRANGAN/MR. B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai-TamilNadu-INDIA Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com | , ,                                                                                                                                                  |
| 151 | 145-15000-A | TEMPERATURE SWITCH | D021 | DRESSER INDUSTRIES INC.               | REGULAR | NA | Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat-India Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com                           | , ,                                                                                                                                                  |
| 152 | 145-15000-A | TEMPERATURE SWITCH | S009 | SWITZER PROCESS INSTRUMENTS PVT. LTD. | REGULAR | NA | B Kannan/V S Jayaprakash 9, SOUTH BOAG ROAD, II FLOOR, PB NO-1423, T.NAGAR, CHENNAI-TAMIL NADU-INDIA Phone- 044-24340999 / 24344 Pincode : 600017 Email : marketing@switzerinstrument.com       | Name changed from "M/s Switzer Instrument Ltd." to "M/s Switzer Process Instruments Pvt. Ltd." w.e.f. 27.07.2016; , ,                                |
| 153 | 145-15000-A | TEMPERATURE SWITCH | S010 | SOR INC.                              | REGULAR | NA | LARRY DEGARMO/Avdesh Chandra, 14685 W. 105TH STREET LENEXA-KANSAS-USA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdesh@sherman-india.com                                 | , ,                                                                                                                                                  |
| 154 | 145-15000-A | TEMPERATURE SWITCH | T001 | TOSHNIWAL BROTHERS PVT.LTD.           | REGULAR | NA | WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER-RAJASTHAN-INDIA Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com                                               | , ,                                                                                                                                                  |
| 155 | 145-14000-A | TRANSMITTERS       | T031 | Honeywell Automation India Limited    | REGULAR | NA | Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI-DELHI-INDIA Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com                                | , ,                                                                                                                                                  |
| 156 | 145-14000-A | TRANSMITTERS       | Y10  | YOKOGAWA INDIA LIMITED,               | REGULAR | NA | PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE,- KARNATAKA,-INDIA, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,                                            | Subject to submission of renewed ISO certificate & compliance to GCC; Relevant documents (ISO 9001:2008 and GCC Rev-05) furnished on 18.06.2013. , , |
| 157 | 145-14000-A | TRANSMITTERS       | T111 | TOSHNIWAL INDUSTRIES PVT. LTD.,       | REGULAR | NA | Industrial Estate, Makhupura, Ajmer,- Rajasthan,-India, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com                                                                              | GCC Rev.5 has been accepted in toto. , ,                                                                                                             |
| 158 | 145-14000-A | TRANSMITTERS       | V040 | V. AUTOMAT & INSTRUMENTS (P) LTD.     | REGULAR | NA | Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI-DELHI-INDIA Phone- 9810005826 Pincode : 110 020 Email : caloc@vautomat.com                                              | Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014 ,                                                                   |
| 159 | 145-14000-A | TRANSMITTERS       | S039 | SMART INSTRUMENTS LTD, BRAZIL         | REGULAR | NA | Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI-MAHARASHTRA-INDIA Phone- 28208477 Pincode : 400093 Email : corp@delby.rpgms.ems.vsnl.net.in                     | Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014 ,                                                                   |

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| 160 | 145-14000-A | TRANSMITTERS | S106 | SBEM PVT. LTD.                              | REGULAR | NA | MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE,- MAHARASHTRA-INDIA Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in   | Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry; , Technical limit reviewed on 30.04.2014 & 12.10.2015; ,         |
| 161 | 145-14000-A | TRANSMITTERS | S001 | SIEMENS LIMITED                             | REGULAR | NA | Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai-Maharashtra-INDIA Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com                  | Comm Add: Attn Mr K.K.Bedi/ Mr Sanjay Satpute, Siemens Ltd. EFIE, Plot no 6A, Sec-18, Maruti Industrial Area, Gurgaon - 122015, Ph 0124-3836250 , , |
| 162 | 145-14000-A | TRANSMITTERS | R002 | EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD. | REGULAR | C  | Mr. Amit Paithankar/Vikram Raj Singh 206- 210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI-MAHARASHTRA-INDIA Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.co | , ,                                                                                                                                                 |
| 163 | 145-14000-A | TRANSMITTERS | P068 | Pune Techtrol Pvt. Ltd.                     | REGULAR | C  | N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune-Maharashtra-INDIA Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com                                              | Technical limit reviewed on 12.10.2015; , Manufacturing works: J-52/7, MIDC, Bhosari, Pune.                                                         |
| 164 | 145-14000-A | TRANSMITTERS | P082 | PANAM ENGINEERS                             | REGULAR | NA | Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai,-Maharashtra,-India, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com, | , ,                                                                                                                                                 |
| 165 | 145-14000-A | TRANSMITTERS | N040 | NIVO CONTROLS PVT. LTD.                     | REGULAR | C  | Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore-M.P.-India Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com                                            | Registered in permanent category as per 11th MISCC-Electrical and C&I (FY 2014-15) dt. 20.09.2014. , Technical limit reviewed on 12.10.2015; ,      |
| 166 | 145-14000-A | TRANSMITTERS | M091 | Moore Industries International Inc.         | REGULAR | NA | Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills-CALIFORNIA-USA Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com                                       | INDIAN REPRESENTATIVE: CHEMTROL INDUSTRIES LTD. , ,                                                                                                 |
| 167 | 145-14000-A | TRANSMITTERS | E057 | Endress + Hauser (India) Pvt. Ltd.,         | REGULAR | NA | Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi,- New Delhi,-India, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com       | For temperature transmitter only. , ,                                                                                                               |

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| 168 | 145-14000-A | TRANSMITTERS                | B049 | ABB LIMITED                        | REGULAR | A1 | MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD-HARYANA-INDIA Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com                          | (1) A GROUP COMPANY OF ABB, NOW. (2) NAME OF VENDOR CHANGED FROM BIRLA-KENT TAYLOR LIMITED TO ABB LIMITED W.E.F. 27.06.2011 , Technical limit reviewed and changed on 05.06.2014; Technical limit further reviewed on |
| 169 | 145-42000-A | ULTRASONIC FLOW METERS      | N209 | NIVUS GMBH                         | REGULAR | NA | Mr. Marcus Fischer Im Taele 2, D - 75031 Eppingen -- Germany Phone- 00491712233770 Pincode : Email : carolin.schuster@nivus.com                       | , ,                                                                                                                                                                                                                   |
| 170 | 145-33000-A | VENTURI METER               | M009 | MICRO PRECISION PRODUCTS PVT. LTD. | REGULAR | NA | K.P. CHANDHOK/ATUL CHANDHOK 4, LINK ROAD, FARIDABAD-HARYANA-INDIA Phone- 9810265688 Pincode : 121002 Email : nal@micro1.com                           | , ,                                                                                                                                                                                                                   |
| 171 | 145-33000-A | VENTURI METER               | S044 | STAR-MECH CONTROLS (I) PVT.LTD.    | REGULAR | C  | SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE- MAHARASHTRA-INDIA Phone- 02026970450 Pincode : 411028 Email : sushil@star-mech.net   | , ,                                                                                                                                                                                                                   |
| 172 | 145-33000-A | VENTURI METER               | T108 | TM TECNOMATIC SPA                  | REGULAR | NA | MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzoc VIA DELLE INDUSTRIE, 36 CREMONA- ITALY Phone- 39037221574 Pincode : 26100 Email : info@tmtcnomatic.com        | AS PER DECISION OF MISCC-ELECT AND C&I HELD ON 19.10.2012 , ,                                                                                                                                                         |
| 173 | 145-40000-A | VIBRATION MONITORING SYSTEM | S156 | SKF INDIA LIMITED                  | REGULAR | NA | Mr. Shishir Joshipura SERVICE BUSINESS UNIT, CHINCHWAD, PUNE- MAHARASHTRA-INDIA Phone- +91 982 3161755 Pincode : 411033 Email : sandeep.gadre@skf.com | PARENT COMPANY: SKF CONDITION MONITORING INC, USA. ENTIRE RESPONSIBILITY OF ALL CONTRACTUAL OBLIGATIONS SHALL BE OF INDIAN VENDOR AS DECIDED BY 4TH MISCC (ELECT AND C&I) HELD ON                                     |
| 174 | 145-40000-A | VIBRATION MONITORING SYSTEM | R056 | ROCKWELL AUTOMATION INDIA PVT LTD  | REGULAR | NA | A-66, SEC- 64, NOIDA, UP-India Phone- 0120-4671236 Pincode : 201301 Email : ra.india@ra.rockwell.com; asharma@ra.rockwell.com                         | PARENT COMPANY: ROCKWELL AUTOMATION INC, USA. ENTIRE RESPONSIBILITY OF ALL CONTRACTUAL OBLIGATIONS SHALL BE OF INDIAN VENDOR AS DECIDED BY 4TH MISCC (ELECT AND C&I) HELD ON                                          |

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| 175 | 145-40000-A | VIBRATION MONITORING SYSTEM | M097 | MEGGITT INDIA PVT. LTD.       | REGULAR | NA | LJ Swaminathan/Gaurav Anand Unit-04A, Level-02, Bagmane Laurel Bagmane Tech Park, CV Raman Nagar Bangalore-Karnataka-India Phone- +91-9731577119 Pincode : 560093 Email : gaurav.anand@meggitt.com | PARENT COMPANY: MEGGITT SA, SWITZERLAND. ENTIRE RESPONSIBILITY OF ALL CONTRACTUAL OBLIGATIONS SHALL BE OF INDIAN VENDOR AS DECIDED BY 4TH MISCC (ELECT AND C&I) HELD ON            |
| 176 | 145-40000-A | VIBRATION MONITORING SYSTEM | F034 | FORBES MARSHALL PVT. LTD.     | REGULAR | NA | A - 34/35, MIDC ESTATE, H-BLOCK, PIMPRI, PUNE- MAHARASHTRA-INDIA Phone- 020-27442020, Pincode : 411 018 Email : mvyas@forbesmarshall.com                                                           | IN ASSOCIATION WITH SHINKAWA ELECTRIC CO. LTD., JAPAN (V.CODE S155) AS PER AGREED SCOPE MATRIX. ENTIRE RESPONSIBILITY OF ALL CONTRACTUAL OBLIGATIONS SHALL BE OF INDIAN VENDOR , , |
| 177 | 145-40000-A | VIBRATION MONITORING SYSTEM | G068 | GE INDIA INDUSTRIAL PVT. LTD. | REGULAR | NA | Mr. Pramod Kaushik/Vijay Pal BUILDING NO-7A, 4TH FLOOR GURGAON- HARYANA-INDIA Phone- 0124-4808515 Pincode : 122002 Email : vijay.pal@ge.com                                                        | PARENT COMPANY: BENTLY NEVADA INC, USA. ENTIRE RESPONSIBILITY OF ALL CONTRACTUAL OBLIGATIONS SHALL BE OF INDIAN VENDOR AS DECIDED BY 4TH MISCC (ELECT AND C&I) HELD ON             |

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

Anshul

S A Khan

Pramod Kaushik

| SI No. | Package Name          | Vendor Name                              | LOCATION     |
|--------|-----------------------|------------------------------------------|--------------|
| 1      | LOCAL CONTROL PANELS  | C and S ELECTRIC LTD.                    | New Delhi    |
|        |                       | PYROTECH ELECTRONICS PVT. LTD.           | Udaipur      |
|        |                       | PROCON INSTRUMENTATION PVT. LTD.         | Chennai      |
|        |                       | INDUSTRIAL CONTROLS & APPLIANCES PVT LTD | Mumbai       |
| 2      | ANALYSERS (ALL TYPES) | ABB INDUSTRIES AG                        | SWITZERLAND. |
|        |                       | ROSEMOUNT ANALYTICAL INC                 | IRVINE       |
|        |                       | ENDRESS + HAUSER INDIA PVT. LTD.         | MUMBAI       |
|        |                       | HACH LANGE S.A.R.L CH-1222,              | VESENAZ      |
|        |                       | SWAN Analytische Instrumente AG, CH-8340 | Hinwii       |
|        |                       | METTLER-TOLEDO INDIA PVT. LTD.,          | MUMBAI       |
|        |                       | THERMO ORION INC                         | BEVERLY      |
| 3      | UPS                   | EMERSON NETWORK POWER,                   | AMBERNATH    |
|        |                       | EMERSON NETWORK POWER                    | PUNE         |
|        |                       | HITACHI-HIREL,                           | GANDHINAGAR  |
|        |                       | KELTRON,                                 | TRIVANDRUM   |
|        |                       | CONSUL NEOWATT POWER SOLUTIONS,          | PUNE         |
| 5      | MOTORISED ACTUATOR    | ROTARK                                   | UK           |
|        |                       | AUMA                                     | Bengaluru    |
|        |                       | WEIR BDK VALVES                          | Hubli        |
|        |                       | LIMITORQUE                               | Faridabad    |
| 6      | AIR FILTER REGULATOR  | PLACKA                                   | Chennai      |
|        |                       | SHAVO-NORGREN                            | Mumbai       |
|        |                       | SCHRADER SCHORILL DUNCAN LTD.            | Mumbai       |
|        |                       | FAIRCHILD                                | USA          |
|        |                       | SMC PNEUMATICS                           | Noida        |
| 7      | SOLENOID VALVE        | ASCO                                     | USA          |
|        |                       | ROTEX                                    | Vadodra      |
|        |                       | SCHRADER                                 | Pune         |
|        |                       | AVCON                                    | Mumbai       |
|        |                       | HERION-NORGREN                           | Germany      |
|        |                       | IMI-NORGREN                              | Germany      |
|        |                       | JAFFERSON                                | Argentina    |

Notes :-

1) The above sub-vendor list is tentative & reference only. However sub-vendor list is subject to BHEL/end user approval without any commercial/delivery implication.

2) New subvendor, if proposed by vendor during contract st    nd user approval without any commercial implication.

# CONTROL SYSTEM FOR MECHANICAL AUXILIARY PACKAGES

| REV. | DATED.                                                                                  | ALTD | CHD | APPD | DH-APP |
|------|-----------------------------------------------------------------------------------------|------|-----|------|--------|
| 03   | 12.01.17                                                                                | VS   | SK  | SCS  | DP     |
| 1.   | REVISED IN LINE WITH CUSTOMER COMMENTS<br>RECEIVED VIDE LTR No. D.25/16, dated 25.11.16 |      |     |      |        |

|         |          |
|---------|----------|
| JOB NO. | 412      |
| STATUS  | CONTRACT |

|                                                                                     |
|-------------------------------------------------------------------------------------|
| PRINT SCALE                                                                         |
|  |

| REV. | DATED.                                                                                   | ALTD | CHD | APPD | DH-APP |
|------|------------------------------------------------------------------------------------------|------|-----|------|--------|
| 02   | 07.07.15                                                                                 | VS   | SK  | SCS  | DP     |
| 1.   | REVISED IN LINE WITH CUSTOMER COMMENTS<br>RECEIVED VIDE LTR NO. D.69/15, DATED 10.06.15. |      |     |      |        |

| REV. | DATED.                                                                              | ALTD | CHD | APPD | DH-APP |
|------|-------------------------------------------------------------------------------------|------|-----|------|--------|
| 01   | 04.03.15                                                                            | AR   | SCS | SCS  | DP     |
| 1.   | REVISED AS PER CUSTOMER'S COMMENTS<br>DATED 09.02.15 & BHEL'S REPLY DTD<br>04.03.15 |      |     |      |        |

|          |                                                                                            |
|----------|--------------------------------------------------------------------------------------------|
| PROJECT- | 2 X 660 MW ENNORE SEZ SUPERCRITICAL THERMAL<br>POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI |
|----------|--------------------------------------------------------------------------------------------|

|                                                                                     |       |                                                              |
|-------------------------------------------------------------------------------------|-------|--------------------------------------------------------------|
|  | OWNER | TAMILNADU GENERATION AND DISTRIBUTION<br>CORPORATION LIMITED |
|-------------------------------------------------------------------------------------|-------|--------------------------------------------------------------|

|  |                       |                                                   |
|--|-----------------------|---------------------------------------------------|
|  | OWNER'S<br>CONSULTANT | DESEIN PRIVATE LIMITED<br>DESEIN HOUSE, NEW DELHI |
|--|-----------------------|---------------------------------------------------|

|                                                                                     |                   |                                                                                         |                   |      |      |          |
|-------------------------------------------------------------------------------------|-------------------|-----------------------------------------------------------------------------------------|-------------------|------|------|----------|
|  | EPC<br>CONTRACTOR | BHARAT HEAVY ELECTRICALS LTD<br>POWER SECTOR<br>PROJECT ENGINEERING MANAGEMENT<br>NOIDA | DEPT<br>CODE<br>I | NAME | SIGN | DATE     |
|                                                                                     |                   |                                                                                         | DSGN              | AR   | -SD- | 17.01.15 |
|                                                                                     |                   |                                                                                         | CHD               | SCS  | -SD- | 17.01.15 |
|                                                                                     |                   |                                                                                         | APPD              | DP   | -SD- | 17.01.15 |

|       |                                                  |
|-------|--------------------------------------------------|
| TITLE | CONTROL SYSTEM FOR MECHANICAL AUXILIARY PACKAGES |
|-------|--------------------------------------------------|

|  |  |  |  |  |  |       |                                                                                     |                      |
|--|--|--|--|--|--|-------|-------------------------------------------------------------------------------------|----------------------|
|  |  |  |  |  |  | DEPT. | SCALE                                                                               | DRAWING NO.          |
|  |  |  |  |  |  | SIGN  |  | PE-DM-412-145-I900   |
|  |  |  |  |  |  | DATE  |                                                                                     | SHEET 1 OF 10 REV 03 |

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| 2. CONTROL SYSTEM MATRIX FOR MECHANICAL<br>AUXILIARY PACKAGES          | ..... | 04    |
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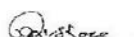


TITLE : CONTROL SYSTEM FOR  
MECHANICAL AUXILIARY PACKAGES  
INDEX

DRG. NO.  
PE-DM-412-145-I900  
REV. 03  
SH. 02 OF 10 SHS.

  
Anshul

  
S A Khan

  
Pawan Kishore

|                                                                                   |                                                        |                                    |                 |
|-----------------------------------------------------------------------------------|--------------------------------------------------------|------------------------------------|-----------------|
|  | DOCUMENT TITLE                                         | DOCUMENT <b>PE-DM-412-145-1900</b> |                 |
|                                                                                   | <b>CONTROL SYSTEMS FOR MECHANICAL AUXILIARY SYSTEM</b> | REVISION NUMBER 02                 | DATE 12.01.2017 |
|                                                                                   | <b>2 X 660 MW ENNORE SEZ STPP</b>                      | SHEET 3 OF 10                      |                 |

### DESCRIPTION OF CONTROL SYSTEMS FOR MECHANICAL AUXILIARY PACKAGE

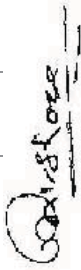
1. This document covers control system matrix of different Mechanical Auxiliary packages (Supplied / Engineered by BHEL PEM), PLC System Configuration diagram and power supply arrangement for PLC based control system.
2. The Mechanical Auxiliary packages in terms of control location, type of control system (PLC/DCS/Relay/Microprocessor), communication with main plant DCS, time sync etc., shall be as per page 4 of 11.
- 2 3. Package specific PLC system configuration diagram shown on pages 5 – 10 are indicative only. Further details shall be furnished in, package specific vendor drawings of PLC system Configuration, which shall be submitted after ordering. Soft link shall be provided for communication between plant DCS and PLC system. Soft link shall be redundant and OPC compliant over fibre optic link. All PLC based system shall be time synchronized with plant Master clock system using IRIG-B signals.
- 2 4. PLC based control system shall be powered through dedicated Parallel Redundant UPS with battery & ACDB. Remote I/O panels shall be powered from UPS/24V DC source of respective nearest unit. 3
5. The operating philosophy, interlock & protection for each package shall be provided separately in design memoranda / detailed write-up of the respective package.
- 3 6. Backup Control desk & local control panels shall be provided as per technical specification & post bid resolution requirements.
- 3 7. Hardwired interfacing shall be included for signal exchange between Air conditioning PLC and local control panels for Air conditioning & Ventilation system.

| 2X680 MW ENMORE SEZ STPP                         |                                                                      |                     |                                                    |                                                                                            |                                                                     |                                       |              |             |               |            |                 |                            |
|--------------------------------------------------|----------------------------------------------------------------------|---------------------|----------------------------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------|--------------|-------------|---------------|------------|-----------------|----------------------------|
| CONTROL SYSTEM FOR MECHANICAL AUXILIARY PACKAGES |                                                                      |                     |                                                    |                                                                                            |                                                                     |                                       |              |             |               |            |                 |                            |
| (DRG. NO. PE-DW-412-145-000) , REV 03            |                                                                      |                     |                                                    |                                                                                            |                                                                     |                                       |              |             |               |            |                 |                            |
| SHT 04 of 10                                     |                                                                      |                     |                                                    |                                                                                            |                                                                     |                                       |              |             |               |            |                 |                            |
| Sl. No.                                          | System / Package                                                     | ControlSystem Scope | Common / per unit                                  | Control System                                                                             |                                                                     | Type of interface with main plant DCS |              |             | Communication |            |                 | Redundant Time Sync Format |
|                                                  |                                                                      |                     |                                                    | Type                                                                                       | Location                                                            | Local                                 | Remote (CCR) | Link        | Purpose       | Cable Type | Redundant (Y/N) | Protocol                   |
| 1                                                | Mill Reject system                                                   | EDN                 | MRS unitwise & MRS compressors common              | Standalone DCS                                                                             | MRS Control Room                                                    | Y                                     | N            | —           | —             | —          | Y               | —                          |
| 2                                                | Chemical Dosing system (LP)                                          | EDN                 | Per Unit                                           | DCS                                                                                        | CCR                                                                 | Y*                                    | Y            | —           | —             | —          | —               | —                          |
| 3                                                | Oxygen dosing system                                                 | EDN                 | Per Unit                                           | DCS                                                                                        | CCR                                                                 | Y*                                    | Y            | —           | —             | —          | —               | —                          |
| 4                                                | COLTCS                                                               | EDN                 | Per Unit                                           | DCS                                                                                        | CCR                                                                 | Y*                                    | Y            | —           | —             | —          | —               | —                          |
| 5                                                | SCS                                                                  | EDN                 | Per Unit                                           | DCS                                                                                        | CCR                                                                 | Y                                     | Y            | —           | —             | —          | —               | —                          |
| 6                                                | Debris filter                                                        | EDN                 | Per Unit                                           | DCS                                                                                        | CCR                                                                 | N                                     | Y            | —           | —             | —          | —               | —                          |
| 7                                                | Fuel oil handling & storage system                                   | EDN                 | Common                                             | DCS (RPU)                                                                                  | FOPH Control Room                                                   | Y                                     | Y            | —           | —             | —          | —               | —                          |
| 8                                                | Effluent Treatment Plant                                             | EDN                 | Common                                             | Standalone DCS                                                                             | ETP Control room                                                    | Y                                     | N            | —           | —             | —          | Y               | —                          |
| 9                                                | CW/ACW system                                                        | EDN                 | PER UNIT                                           | DCS (RPU)                                                                                  | OWPH                                                                | Y                                     | Y            | —           | —             | —          | —               | —                          |
| 10                                               | Sea Water Intake pumps & TWS                                         | EDN                 | Common                                             | Standalone DCS                                                                             | Sea Wtr Intake Pump house control room                              | Y                                     | N            | —           | —             | —          | Y               | —                          |
| 11                                               | Filtered water sys/Clarified water sys/DM MU/ pump & other misc pump | EDN                 | Common                                             | Standalone DCS                                                                             | Filtered water & Misc pump control room                             | Y                                     | N            | —           | —             | —          | Y               | —                          |
| 12                                               | Air Conditioning & Ventilation system                                | PEM-VEND            | Common                                             | PLC                                                                                        | AC Plant control room                                               | Y                                     | N            | Soft        | Monitoring    | FO         | Y               | OPC                        |
| 13                                               | Compressed Air system                                                | PEM-VEND            | Common                                             | Microprocessor based sys for individual compressors and one number PLC for all compressors | Compressor house                                                    | Y                                     | N            | Soft & H/W* | Monitoring    | TP         | Y               | MODBUS on RS-485           |
| 14                                               | H2 Generation Plant                                                  | PEM-VEND            | Common                                             | PLC                                                                                        | H2 Gen Plant                                                        | Y                                     | N            | Soft        | Monitoring    | FO         | Y               | OPC                        |
| 15                                               | Condensate polishing unit                                            | PEM-VEND            | Service vessel unitwise & regeneration area common | PLC                                                                                        | PLC in CPU regeneration Control room and RIO in service vessel area | Y                                     | N            | Soft        | Monitoring    | FO         | Y               | OPC                        |
| 16                                               | Pretreatment Plant                                                   | PEM-VEND            | Common                                             | PLC                                                                                        | Pretreatment Control room                                           | Y                                     | N            | Soft        | Monitoring    | FO         | Y               | OPC                        |
| 17                                               | Electrolytic Chlorination plant (for CW & Pretreatment plant)        | PEM-VEND            | Common                                             | PLC                                                                                        | Electro Chlorination Plant Control room                             | Y                                     | N            | Soft        | Monitoring    | FO         | Y               | OPC                        |
| 18                                               | Sewage Treatment Plant                                               | PEM-VEND            | Common                                             | Standalone DCS                                                                             | ETP Control room                                                    | Y                                     | N            | —           | —             | —          | Y               | —                          |

LEGEND

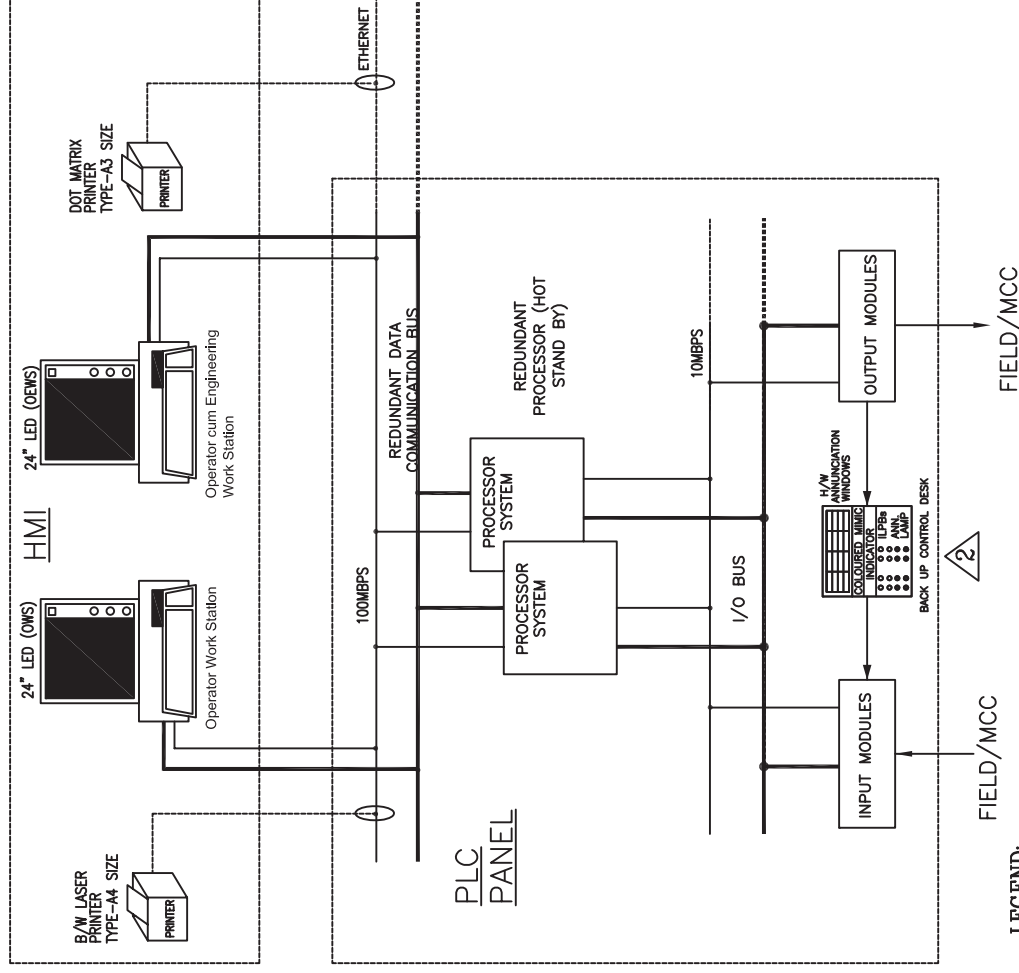
1 VEND: Package Vendor, 2 CCR: Central Control Room, 3. Communication Cable Type : TP (Twisted pair) / FO (Fibre optic)

  
Anshul

  
Praveen Kishore

# NOTES:

- 1) TABLE TOP OWS/OEWS SHALL BE OF LED 24" OR AVAILABLE INDUSTRY STANDARD.
- 2) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR, COMMUNICATION SYSTEM AND POWER SUPPLY.
- 3) UPS POWER SUPPLY SHALL BE PROVIDED FOR PLC PANEL(S), OWS/OEWS AND NETWORK COMPONENTS.
- 4) UPS POWER SUPPLY SHALL BE IN LINE WITH UPS SCHEME FOR OFFSITE PACKAGES DOCUMENT No.: PE-DG-412-145-I004.
- 5) PLC PANEL SHALL HAVE PROVISION TO ACCEPT REDUNDANT TIME SYNC. SIGNAL (IRIG-B) FROM MASTER CLOCK SYSTEM (PLANT AREA).
- 6) PLC PANEL SHALL HAVE PROVISION FOR REDUNDANT DATA EXCHANGE (OPC) WITH PLANT DCS.
- 8) PROVISION OF HARDWIRED INTERFACE OF AC & VENTILATION CONTROL SYSTEM WITH FIRE PROTECTION & DETECTION CONTROL SYSTEM.
- 9) PLC SYSTEM SHALL BE SUPPLIED AS PER TECHNICAL SPECIFICATION.
- 10) REDUNDANCY OF I/O CARD SHALL BE AS PER SPECIFICATION REQUIREMENT.



## LEGEND: -

- PLC - PROGRAMMABLE LOGIC CONTROLLER
- DCS - DISTRIBUTED CONTROL SYSTEM
- UPS - UNINTERRUPTED POWER SUPPLY
- OWS - OPERATOR CUM ENGINEERING WORK STATION
- HMI - HUMAN MACHINE INTERFACE
- NTP - NETWORK TIME PROTOCOL
- OPC - OLE PROCESS CONTROL
- MCCB - MOULDED CASE CIRCUIT BREAKER
- MCB - MINIATURE CIRCUIT BREAKER



TITLE:-

PLC SYSTEM CONFIGURATION

DRG. NO.

REV. No.

DATE

03

12.01.2017

SHEET

5 OF 10

AC & VENTILATION

Praveen Kishore

S. A. Khan

Anshul

**SUB-SECTION: C-5**  
**TECHNICAL SPECIFICATION (HANDLING EQUIPMENT PORTION)**

# **Material Handling Equipments**

## 1.0 ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)

Required number of electric hoist / manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

Manual hoists (hand operated) shall be designed to duty class 2 as per IS 3832 and electric wire rope hoist shall be designed as per IS: 3938 (latest).

The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.

Maintenance tools and tackles shall be as per data sheet attached.

### DESIGN CRITERIA

For items weighing 300 kg and above, hoists and trolleys along with monorails shall be provided throughout the plant where crane cannot be utilized. For items weighing less than 1000 kg, manual hoists shall be provided. For items weighing 1000 kg and more, electric hoists (lift & travel) shall be provided. In case the lifting height is more than 10m, electric hoist (lift & travel) shall be provided irrespective of the weight. All hoists shall be provided with trolleys.

Capacity of electric and manual (Chain pulley block) hoists shall be decided keeping 25% margin over equipment to be handled.

For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the electrical/ manual hoist with the help of floor operated pendant

### MINIMUM LIFTING REQUIREMENT

| S.N. | AREA DESCRIPTION                   | QTY (nos) | CAPACITY(T) | TYPE |
|------|------------------------------------|-----------|-------------|------|
| 1    | LIST TO BE MENTIONED AS APPLICABLE |           |             |      |
| 2    |                                    |           |             |      |
| 3    |                                    |           |             |      |

Note:

1. Area, type, capacity mentioned are minimum requirement and shall be finalised during detail engineering without any commercial implication
2. Travel and Lift are layout dependent and shall be finalised during detail engineering without any commercial implication
3. Additional electric/manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

## 2.0 SCOPE OF SUPPLIES

Equipment and services to be furnished by the bidder for the ELECTRIC HOIST/ MANUAL HOIST with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified in the specification but required to make the ELECTRIC HOIST/ MANUAL HOIST complete and efficient operation shall also be under the bidder's scope of work.

Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

- 2.1.0 Electric hoist shall include but not be limited to the following: -
- Hoisting and CT drive arrangement
  - All electrical equipment including cables (as per electrical scope matrix) and panels.
  - PVC insulated shrouded bus bar DSL
  - Earthing arrangement.
  - Initial fill of lubricant.
  - Painting of electric hoist and accessories.
  - Maintenance Tools & Tackles (as per attached list at SI No-11 below)
  - Erection & Commissioning spares
  - Isolating switch in enclosure at operating floor for disconnecting supply to DSL while maintaining the electric hoist.
- 2.2.0 Erection and Commissioning spares (ELECTRIC HOIST)  
The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.
- 2.3.0 Services to be provided by the bidder  
Packing, forwarding and transportation to site, storage and handling at site.
- 2.4.0 Erection and Commissioning
- 2.5.0 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant Indian standards)
- 2.6.0 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.

### **3.0 Inspection and Testing**

As per enclosed reference quality plan and as per IS 3938 (latest revision). Prime inspection agency shall be Consultant/ End Customer. Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement/CHP (Customer Hold Point) at any stage of inspection deemed necessary by Consultant/ End Customer during detailed engineering shall be carried out without any commercial or technical implication.

### **4.0 Works Excluded**

Supply of ISMB monorail.

### **5.0 PAINTING SPECIFICATION**

As per painting details specified elsewhere in specification.

### **6.0 PACKING**

In general packing shall be wooden box packing.

### **7.0 TESTING AT VENDOR'S WORKS**

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP and as per IS 3938 for electric hoist and IS 3832 for manual hoist.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed

performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

## **8.0 MAKE OF SUB - VENDOR ITEMS**

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client. (Refer annexure-I)

## **9.0 TESTING AT SITE**

### **A) ELECTRIC HOIST:**

As required for statutory clearance for operating at site i.e., overload test, load test and other tests as per IS 3938.

Test for Operation -After the supply has been connected, tests shall be carried out to prove the following:

- a) The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavorable conditions;
- b) The correctness of all circuits and interlocks and sequence of operation; and
- c) The satisfactory operation of all protective devices.

Overload Test -After test but before the hoist is put into service, it shall be tested with overload relays appropriately set, to lift and sustain a test load of 125 percent of the working load. During the overload test, the hoist shall sustain the load under full control. The specified speeds need not be attained but the hoist shall show itself capable of dealing with the overload without difficulty.

### **B) MANUAL HOIST:**

As required for statutory clearance for operating at site with following minimum test i.e., overload and load test.

## **10.0 TECHNICAL DATA SHEET:**

### **A) Technical data sheet-A for ELECTRIC HOIST:**

| Sl.no | DESCRIPTION                                 | TECHNICAL PARTICULARS                                                                                                                                           |
|-------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.0   | Type                                        | Steel wire electric hoist with electrically operated trolley                                                                                                    |
| 2.0   | Scope (Qty., Capacity, Lift, Travel Length) | As per specification and layout requirement                                                                                                                     |
| 3.0   | Type of service                             | Indoor                                                                                                                                                          |
| 4.0   | Overload test                               | 125% of SWL                                                                                                                                                     |
| 5.0   | Design Ambient temperature                  | 50° C                                                                                                                                                           |
| 6.0   | General Design                              | As per IS: 3938 / 1983 or latest, Class-II duty                                                                                                                 |
| 6.1   | Design standards                            | IS: 3938, IS: 2266, IS: 4029, IS: 900, IS: 4237, IS: 694, IS: 3043, IS: 1822, IS: 2147. IS: 1554, IS: 325, IS: 15660, IS 9968 Part I etc as per latest revision |
| 6.2   | Duty class                                  | Class II duty                                                                                                                                                   |
| 7.0   | Operating speed                             |                                                                                                                                                                 |
| 7.1   | Hoisting speed                              | 3 MPM                                                                                                                                                           |
| 7.2   | Trolley speed                               | 6 MPM                                                                                                                                                           |
| 8.0   | Type of transmission                        | Through Electric motor and gear box.                                                                                                                            |
| 9.0   | Wire Rope                                   |                                                                                                                                                                 |
| 9.1   | Construction / core                         | 6 x36 construction, steel core/Fibre core                                                                                                                       |

|      |                                |                                                                                           |
|------|--------------------------------|-------------------------------------------------------------------------------------------|
| 9.2  | Code                           | IS:2266                                                                                   |
| 9.3  | Number of falls                | Min. 4                                                                                    |
| 9.4  | Factor of safety               | Not less than 5                                                                           |
| 10.0 | Load Hook and block            | NORMALISED HOOK ONLY                                                                      |
| 10.1 | Type of load hook              | Plain shank trapezoidal section with safety latch.                                        |
| 10.2 | Load hook Code                 | IS: 15560                                                                                 |
| 10.3 | Load hook Material             | As per IS:15560                                                                           |
| 10.4 | Hook suspension                | Thrust bearing                                                                            |
| 10.5 | Material of block suspension   | Fabricated from steel plate, Material: IS: 2062                                           |
| 11.0 | Gearing                        |                                                                                           |
| 11.1 | Type                           | Spur / Helical                                                                            |
| 11.2 | Gear/ pinion material          | as per IS 3938                                                                            |
| 11.3 | Lubrication                    | Oil splash/ grease lubricated                                                             |
| 11.4 | Bearing type                   | Antifriction Ball / Roller                                                                |
| 12.0 | Trolley drive                  |                                                                                           |
| 12.1 | Wheel                          | Single flange taper thread                                                                |
| 12.2 | Wheel conform to (Std. / code) | IS: 3938                                                                                  |
| 12.3 | Wheel material                 | C55Mn75/ En-8/ En-9. (Max hardness 200 BHN)                                               |
| 12.4 | Bearing type                   | Antifriction Ball / Roller                                                                |
| 12.5 | Trolley type                   | Rolled structural steel with side plates extended beyond wheel flanges to protect wheels. |
| 12.6 | Hardness                       | Max hardness 200 BHN                                                                      |
| 13.0 | SHEAVE                         |                                                                                           |
| 13.1 | Material                       | Fabricated from steel plate. IS: 2062 Gr. A or Gr. B / as per IS: 3938                    |
| 13.2 | Bearing type                   | Antifriction Ball / Roller.                                                               |
| 14.0 | BRAKE (HOIST and TROLLEY)      |                                                                                           |
| 14.1 | Type                           | DCEM brakes disc type (fail to safety).                                                   |
| 14.2 | Capacity                       | As per IS 3938.                                                                           |
| 14.3 | Number                         | One number for each motor.                                                                |
| 15.0 | ROPE DRUM                      |                                                                                           |
| 15.1 | Material                       | Cast iron, cast steel or mild steel.                                                      |

|      |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |
|------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 15.2 | Flange / Flangeless                         | Flanged                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |
| 15.3 | Type of groove                              | As per manufacturers standard to suit the layout requirement.(Shall be decided during detail engineering)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |
| 17.0 | TYPE OF DSL                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |
| 17.1 | CT travel                                   | PVC Shrouded bus bar conductor type DSL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |
| 18.0 | MOTORS                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |
| 18.1 | Type                                        | Sq. Cage induction, TEFC, S4 duty, 40% CDF.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |            |
| 18.2 | Number of start                             | 300 starts / hr                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |
| 18.3 | Voltage , Phase and Frequency               | 415V $\pm$ 10%, 3 phase, 4 wire, 50 Hz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |
| 18.4 | Class of insulation                         | Class "F" and temperature rise limited to class B.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |
| 18.5 | Type of enclosure                           | TEFC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |
| 18.6 | Degree of protection provided for enclosure | IP-54/55 (indoor/outdoor)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |
| 18.7 | Margin                                      | 10% over maximum continuous load demand                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |
| 19.0 | LIMIT SWITCHES                              | Hoisting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Trolley    |
| 19.1 | Type                                        | Snap action, self actuating type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Lever type |
| 20.0 | Control panel                               | <ul style="list-style-type: none"> <li>* Fabricated from Cold rolled sheet steel not less than 2.5mm for front &amp; rear &amp; 2mm for side, top &amp; bottom portion with gland plate of 3mm thick.</li> <li>* Degree of protection shall be IP 54.</li> <li>* Power on indicating lamps shall be provided</li> <li>* Panel illumination lamps operated by door switch.</li> <li>* 2 nos earthing terminals on panel.</li> <li>* 20 % spares terminals (clip on type) shall be provided.</li> <li>* Power and control terminals ( clip on type) shall be on separate channels.</li> <li>* Gland plate shall be double brass compression type.</li> </ul> |            |
| 20.1 | Qty                                         | 1 No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |
| 21.0 | Pendent Push buttons                        | Up /down / forward / Reverse push buttons.<br>Indicative marking for easy operation shall be provided.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |
| 22.0 | Power cables                                | 1.1 KV grade XLPE power cables shall have compacted aluminium conductor for cables including 10 sq. mm and above and copper conductor for cables below 10 sq.mm, XLPE insulated, PVC inner-sheathed (as applicable), armoured, FRLS PVC outer-sheathed conforming to IS: 7098. (Part-I).                                                                                                                                                                                                                                                                                                                                                                   |            |
| 23.0 | Control cable                               | Control cable shall be multi core, minimum 2.5 sq.mm cross section, stranded copper conductor, PVC insulated, inner PVC sheathed / galvanized steel wire armored and outer sheath made of FRLS PVC compound. In situation where accuracy of measurement or voltage drop in control circuit, warrant, higher cross sections as required                                                                                                                                                                                                                                                                                                                     |            |

|      |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |                         | shall be used. 4 sq.mm copper conductors shall be used for CT circuits, all other specification remaining same. In 4 sq.mm conductor impose unacceptable high burden on CTs, higher cross section of conductor shall be used.                                                                                                                                                                                                                                                          |
| 24.0 | Flexible trailing cable | 1.1 KV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90°C continuous conductor temperature and 250 deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968 |
| 25.0 | Control Voltage         | 110 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

**DATA SHEET-A**

- 1.00.00 Type : Hand operated chain pulley block
- 2.00.00 Area : As per scope sheet attached
- 3.00.00 Design : IS: 3832, IS: 2429, IS 15560, IS 210, IS 4367, IS 6216, IS: 4460. (All standards shall be of latest revision)
- 4.00.00 Duty Class as per IS:3832 : Class –II
- 5.00.00 Hoisting Mechanism
- a) Type : Hand operated gear transmission
- b) Type of gear : Spur / Helical
- c) Load Chain :
- i) Type : Link type
- ii) Material : Alloy steel grade 80 as per IS: 6216
- iii) Conforms to (Std./Code) : IS: 6216
- d) Hand Chain :
- i) Type : Link type
- ii) Material : Mild steel (grade 30) as per IS 2429 Part I
- e) Load Hook & Hook Block :
- i) Type of load hook : Plain shank- Trapezoidal section
- ii) Load hooks conform to : IS: 15560
- / Material
- iii) Type of hook suspension : Swivelling
- iv) Type of make of bearing : Thrust ball bearing
- of hook suspension

- f) Gears/pinion :
- i) Type : Spur
- ii) Material : Alloy steel / carbon steel (Material confirming to IS 3832)
- iii) Type of bearing used : Antifriction ball bearing / Roller
- g) Sprockets
- i) Type of bearings used : Antifriction ball bearing / Roller
- h) Method of lubrications Used
- i) Bearings : Grease
- ii) Gearing & Pinions : Grease
- iii) Sprockets : Grease
- i) Brakes
- i) Type : Ratchet and pawl arrangement along with screw and friction disc type
- 6.00.0 Trolley & Bridge Drive
- a) Trolley
- i) Type : Geared (Manually operated)
- ii) Material of frame : Rolled structural steel (IS:2062 Grade A or B)
- b) Drive Chain
- i) Type : Link type
- ii) Material : Steel Gr.30
- c) Trolley Wheel
- i) Number of pairs of wheel : Two/four
- in each trolley/bridge
- ii) Flange : Single flanged
- iii) Wheel material : Heat Treated Carbon steel/low alloy steel/graded cast iron (Material confirming to IS 3832)
- iv) Type of bearings need : Antifriction
- d) Gears
- i) Type : Spur / helical
- ii) Material : Alloy/ Carbon steel (Material confirming to IS 3832)
- iii) Type of bearings used : Antifriction
- e) Method of lubrication for
- i) Bearings : Grease
- ii) Sprockets : Grease
- f) Load chain wheel
- i) Material : SG iron/ Steel casting/IS 3832
- g) Hand chain wheel
- i) Material : SG iron/ Steel casting/Grey iron Casting./IS 3832

## 11.0 Maintenance Tools and Tackles

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality, specially protected against rusting.

The following shall be provided as minimum requirement:

| S-No. | Description                                                | Qty.  |
|-------|------------------------------------------------------------|-------|
| 1     | Complete set of ring spanners (Indicate the sizes offered) | 1 Set |
| 2     | Complete set of screwdrivers (Indicate the sizes)          | 1 Set |
| 3.    | Adjustable Spanner                                         | 1 No. |
| 4.    | Insulated plier                                            | 1 No. |
| 5.    | Grease gun                                                 | 1 No. |
| 6.    | Oil gun                                                    | 1 No. |
| 7.    | Line tester                                                | 1 No. |

Note: -The tools shall be supplied in one tool box .Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

## 12.0 DRAWING/DOCUMENT SUBMISSION

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

### A) ELECTRIC HOIST

| SI. No. | BHEL DRG.NO        | DRAWING TITLE                                                       |
|---------|--------------------|---------------------------------------------------------------------|
| 1       | PE-V0-412-553-A100 | Manufacturing Quality Plan with Sub vendor list                     |
| 2       | PE-V0-412-553-A101 | GA Drawing for Electric Hoist, DSL arrangement and painting details |
| 3       | PE-V0-412-553-A102 | Schematic Circuit Diagram                                           |
| 4       | PE-V0-412-553-A103 | Mechanism Sizing Calculation                                        |
| 5       | PE-V0-412-553-A104 | Detailed BOM/BOQ for crane                                          |
| 6       | PE-V0-412-553-A105 | O & M Manual                                                        |
| 7       | PE-V0-412-553-A107 | Erection procedure                                                  |

### B) MANUAL HOIST (CHAIN PULLEY BLOCK):

| SI. No. | BHEL DRG.NO        | DRAWING TITLE                                                           |
|---------|--------------------|-------------------------------------------------------------------------|
| 1       | PE-V0-412-553-A200 | Manufacturing Quality Plan                                              |
| 2       | PE-V0-412-553-A201 | GA Drawing for Chain Pulley Block with detail BOM with painting details |
| 3       | PE-V0-412-553-A202 | O & M Manual                                                            |

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

- a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.
- b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
- c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
- d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
- e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ....etc.

**13.0 MANDATORY SPARES:** List of Mandatory Spares for Electric hoists are as follows & no Mandatory Spares are applicable for Chain Pulley Blocks.

| Electric Hoists |                             |                            |
|-----------------|-----------------------------|----------------------------|
| SL NO           | ITEM DESCRIPTION            | QTY                        |
| 1               | Brake linings               | 2 set of each type         |
| 2               | Rope guide & rope tightener | 1 no. of each type         |
| 3               | Limit switch                | 2 set of each type & size  |
| 4               | Gear box / gear set         | 2set of each type          |
| 5               | Drum Bearing                | 1set of each type & rating |

**14.0 MAKES:** Following makes of Electric hoists & Chain Pulley Blocks are acceptable:

|                    |                                 |          |
|--------------------|---------------------------------|----------|
| CHAIN PULLEY BLOCK | TUOBRO FURGUSON (INDIA) PVT LTD | Approved |
|                    | TRACTEL TIRFOR INDIA PVT. LTD.  | Approved |
|                    | HERCULES HOISTS LTD.            | Approved |

|                |                                    |                    |
|----------------|------------------------------------|--------------------|
| ELECTRIC HOIST | Alpha Services                     | Submit Credentials |
|                | Grip Engineers Pvt. Ltd.,          | Submit Credentials |
|                | ARMSEL MHE PVT. LTD                | Submit Credentials |
|                | Mangla Hoists Pvt Ltd              | Submit Credentials |
|                | CONSOLIDATED HOISTS PVT LTD        | Approved           |
|                | LIFTING EQUIPMENTS and ACCESSORIES | Submit Credentials |
|                | REVA INDUSTRIES LTD.               | Approved           |
|                | TUOBRO FURGUSON (INDIA) PVT LTD    | Approved           |
|                | EDDY CRANES PVT. LTD.              | Approved           |
|                | CENTURY CRANE ENGINEERS PVT. LTD.  | Submit Credentials |
|                | HERCULES HOISTS LTD.               | Approved           |

## ANNEXURE-I

### MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO ELECTRIC HOIST:

| SR. NO. | ITEM             | SUPPLIERS                              | PLACE   | REMARKS              |
|---------|------------------|----------------------------------------|---------|----------------------|
| 1.      | STEEL            | SAIL                                   |         |                      |
|         |                  | TISCO                                  |         |                      |
|         |                  | JINDAL                                 |         |                      |
|         |                  | ESSAR                                  |         |                      |
| 2.      | HOOKS            | STEEL FORGING & ENGG. CO.,             | KOLKATA |                      |
|         |                  | SIMRITI FORGING                        |         |                      |
|         |                  | KARACHIWALA                            |         | UP TO 25T CAPACITY   |
| 3.      | GEAR COUPLINGS   | ALLIANCE                               |         |                      |
|         |                  | FLEX-TRANS (formerly known as HICLIFF) |         |                      |
|         |                  | SAHARA                                 |         |                      |
|         |                  | NUTECH                                 |         |                      |
|         |                  | OEM                                    |         |                      |
| 4.      | WIRE ROPE        | USHA MARTIN                            |         |                      |
|         |                  | FORT WILLIAMS                          |         |                      |
|         |                  | BHARAT WIRE ROPES                      |         |                      |
| 5.      | BEARINGS         | SKF                                    |         |                      |
|         |                  | FAG                                    |         |                      |
|         |                  | TATA                                   |         |                      |
|         |                  | NBC                                    |         |                      |
| 6.      | MOTORS           | SIEMENS                                |         |                      |
|         |                  | NGEF (up to 15KW)                      |         |                      |
|         |                  | CROMPTON                               |         |                      |
|         |                  | KIRLOSKAR                              |         |                      |
|         |                  | BHARAT BIJLI                           |         |                      |
|         |                  | MARATHON                               |         |                      |
|         |                  | ABB                                    |         |                      |
|         |                  | LHP                                    |         |                      |
| 7.      | BRAKES           | ELECTROMAG                             |         |                      |
|         |                  | SPEED-O- CONTROL                       |         |                      |
|         |                  | BCH                                    |         | FOR DCEM BRAKES ONLY |
|         |                  | KAKKU                                  |         |                      |
|         |                  | PETHE                                  |         |                      |
| 8.      | CONTACTOR        | SIEMENS                                |         |                      |
|         |                  | L&T                                    |         |                      |
|         |                  | SCHNEIDER (Earlier TELE MECHANIQUE)    |         |                      |
|         |                  | BCH                                    |         |                      |
| 9.      | OVER LOAD RELAYS | SIEMENS                                |         |                      |
|         |                  | L&T                                    |         |                      |

| SR. NO. | ITEM                    | SUPPLIERS                            | PLACE      | REMARKS |
|---------|-------------------------|--------------------------------------|------------|---------|
|         |                         | ABB                                  |            |         |
|         |                         | SCHNEIDER (Earlier TELE MACHANIQUE)  |            |         |
| 10.     | HRC FUSES               | SIEMENS                              |            |         |
|         |                         | L&T                                  |            |         |
|         |                         | ENGLISH ELECTRIC                     |            |         |
|         |                         | GE POWER                             |            |         |
|         |                         | EATON (BUSSMANN)                     |            |         |
|         |                         | ABB                                  |            |         |
| 11.     | ISOLATING SWITCH        | SIEMENS                              |            |         |
|         |                         | L&T                                  |            |         |
|         |                         | CONTROL & SWITCH GEAR                |            |         |
|         |                         | ABB                                  |            |         |
| 12.     | SWITCH FUSE UNITS       | SIEMENS                              |            |         |
|         |                         | L&T                                  |            |         |
|         |                         | CONTROL & SWITCH GEAR                | -          |         |
|         |                         | ABB                                  |            |         |
| 13.     | TIME DELAY RELAYS       | SIEMENS                              |            |         |
|         |                         | L&T                                  |            |         |
|         |                         | ABB                                  |            |         |
|         |                         | BCH                                  |            |         |
|         |                         | SCHNEIDER (Earlier TELE MACHANIQUE ) |            |         |
| 14.     | TRANSFORMERS            | INDCOIL                              |            |         |
|         |                         | LOGICSTAT                            |            |         |
|         |                         | KAPPA                                |            |         |
|         |                         | AUTOMATIC ELECTRIC                   |            |         |
|         |                         | PRECISE ELECTRICALS                  |            |         |
|         |                         | SILKAAN ELECTRIC MFG. CO. LTD.       |            |         |
|         |                         | SOUTHERN ELECTRIC                    |            |         |
|         |                         | NEC                                  |            |         |
| 15.     | CABLE LUGS (HEAVY DUTY) | DOWELLS                              |            |         |
|         |                         | UML ENGINEERS                        | KOLKATA    |         |
|         |                         | JAINSON                              |            |         |
| 16.     | PVC POWER CABLES        | APAR INDUSTRIES LTD.                 | MUMBAI     |         |
|         |                         | CORDS CABLE INDUSTRIES LTD.          | NEW DELHI  |         |
|         |                         | DIAMOND POWER INFRASTRUCTURE LTD     | VADODARA   |         |
|         |                         | GOYOLENE FIBRES (INDIA) PVT.LTD      | MUMBAI     |         |
|         |                         | GOVIND CABLE INDUSTRIES              | KOLKATA    |         |
|         |                         | GUPTA POWER INFRASTRUCTURE LIMITED   | BHUBNESWAR |         |
|         |                         | HAVELLS INDIA LIMITED                | NOIDA      |         |

| SR. NO. | ITEM               | SUPPLIERS                                  | PLACE             | REMARKS |
|---------|--------------------|--------------------------------------------|-------------------|---------|
|         |                    | KEI INDUSTRIES LTD.                        | NEW DELHI         |         |
|         |                    | KRISHNA ELECTRICAL INDUSTRIES LTD          | GWALIOR           |         |
|         |                    | KEC INTERNATIONAL LIMITED                  | MUMBAI            |         |
|         |                    | MANSFIELD CABLES COMPANY LTD.              | NOIDA             |         |
|         |                    | NICCO CORPORATION LTD.                     | KOLKATA           |         |
|         |                    | PARAMOUNT COMMUNICATIONS LTD.              | NEW DELHI         |         |
|         |                    | POLYCAB WIRES PVT. LTD.                    | MUMBAI            |         |
|         |                    | RADIANT CORPORATION PRIVATE LIMITED        | HYDERABAD         |         |
|         |                    | RAVIN CABLES LIMITED                       | MUMBAI            |         |
|         |                    | SUYOG ELECTRICALS LTD.                     | VADODARA          |         |
|         |                    | SRIRAM CABLES PVT. LTD.                    | NEW DELHI         |         |
|         |                    | SCOT INNOVATION WIRES AND CABLES PVT. LTD. | SOLAN             |         |
|         |                    | SAM CABLES & CONDUCTORS (P) LTD            | UDHAM SINGH NAGAR |         |
|         |                    | THERMO CABLES LTD                          | HYDERABAD         |         |
| 17.     | PVC CONTROL CABLES | ADVANCE CABLE TECHNOLOGIES (P) LTD         | BANGALORE         |         |
|         |                    | APAR INDUSTRIES LTD., CMI LTD              | MUMBAI            |         |
|         |                    | CMI LIMITED                                | FARIDABAD         |         |
|         |                    | CORDS CABLE INDUSTRIES LTD                 | NEW DELHI         |         |
|         |                    | CRYSTAL CABLE INDUSTRIES LTD               | KOLKATA           |         |
|         |                    | DELTON CABLES LTD                          | NEW DELHI         |         |
|         |                    | DIAMOND POWER INFRASTRUCTURE LTD           | VADODARA          |         |
|         |                    | ELKAY TELELINKS LTD                        | NEW DELHI         |         |
|         |                    | GEMSCAB INDUSTRIES LTD                     | NEW DELHI         |         |
|         |                    | GOVIND CABLE INDUSTRIES                    | KOLKATA           |         |
|         |                    | GUPTA POWER INFRASTRUCTURE LIMITED         | BHUBNESWAR        |         |
|         |                    | HAVELLS INDIA LIMITED                      | NOIDA             |         |
|         |                    | INCOM CABLES (P) LTD                       | NEW DELHI         |         |
|         |                    | KEI INDUSTRIES LTD                         | NEW DELHI         |         |
|         |                    | KRISHNA ELECTRICAL INDUSTRIES LTD          | GWALIOR           |         |
|         |                    | KEC INTERNATIONAL LIMITED                  | MUMBAI            |         |
|         |                    | MANSFIELD CABLES COMPANY LTD               | NOIDA             |         |
|         |                    | NICCO CORPORATION LTD                      | KOLKATA           |         |
|         |                    | PARAMOUNT COMMUNICATIONS LTD               | NEW DELHI         |         |

| SR. NO. | ITEM              | SUPPLIERS                                 | PLACE             | REMARKS |
|---------|-------------------|-------------------------------------------|-------------------|---------|
|         |                   | POLYCAB WIRES PVT. LTD                    | MUMBAI            |         |
|         |                   | RAVIN CABLES LIMITED                      | MUMBAI            |         |
|         |                   | SUYOG ELECTRICALS LTD                     | VADODARA          |         |
|         |                   | SPECIAL CABLES PVT. LTD                   | NEW DELHI         |         |
|         |                   | SCOT INNOVATION WIRES AND CABLES PVT. LTD | SOLAN             |         |
|         |                   | SAM CABLES & CONDUCTORS (P) LTD           | UDHAM SINGH NAGAR |         |
|         |                   | SPM POWER & TELECOM PVT. LTD              | HYDERABAD         |         |
|         |                   | TORRENT CABLES LTD                        | AHMEDABAD         |         |
|         |                   | THERMO CABLES LTD                         | HYDERABAD         |         |
|         |                   | TIRUPATI PLASTOMATICS PVT. LTD            | JAIPUR            |         |
|         |                   | UNIVERSAL CABLES LTD                      | SATNA             |         |
| 18.     | TRAILING CABLES   | NICCO                                     | KOLKATA           |         |
|         |                   | UNIVERSAL                                 | SATNA             |         |
|         |                   | INCAB                                     |                   |         |
|         |                   | ICL                                       | NEW DELHI         |         |
|         |                   | APAR INDUSTRIES LTD                       | MUMBAI            |         |
|         |                   | CMI LTD                                   | FARIDABAD         |         |
|         |                   | KEI INDUSTRIES LTD                        | NEW DELHI         |         |
|         |                   | SUYOG ELECTRICALS LTD                     | VADODARA          |         |
| 19.     | XLPE POWER CABLES | APAR INDUSTRIES LTD                       | MUMBAI            |         |
|         |                   | CORDS CABLE INDUSTRIES LTD                | NEW DELHI         |         |
|         |                   | CRYSTAL CABLE INDUSTRIES LTD              | KOLKATA           |         |
|         |                   | DIAMOND POWER INFRASTRUCTURE LTD          | VADODARA          |         |
|         |                   | GEMSCAB INDUSTRIES LTD                    | NEW DELHI         |         |
|         |                   | GOVIND CABLE INDUSTRIES                   | KOLKATA           |         |
|         |                   | GUPTA POWER INFRASTRUCTURE LIMITED        | BHUBNESWAR        |         |
|         |                   | HAVELLS INDIA LIMITED                     | NOIDA             |         |
|         |                   | KEI INDUSTRIES LTD                        | NEW DELHI         |         |
|         |                   | KRISHNA ELECTRICAL INDUSTRIES LTD         | GWALIOR           |         |
|         |                   | KEC INTERNATIONAL LIMITED                 | MUMBAI            |         |
|         |                   | MANSFIELD CABLES COMPANY LTD              | NOIDA             |         |
|         |                   | PARAMOUNT COMMUNICATIONS LTD              | NEW DELHI         |         |
|         |                   | POLYCAB WIRES PVT. LTD                    | MUMBAI            |         |
|         |                   | RAVIN CABLES LIMITED                      | MUMBAI            |         |
|         |                   | SUYOG ELECTRICALS LTD                     | VADODARA          |         |
|         |                   | SPECIAL CABLES PVT. LTD                   | NEW DELHI         |         |

| SR. NO. | ITEM                        | SUPPLIERS                                 | PLACE     | REMARKS |
|---------|-----------------------------|-------------------------------------------|-----------|---------|
|         |                             | SCOT INNOVATION WIRES AND CABLES PVT. LTD | SOLAN     |         |
|         |                             | SRIRAM CABLES PVT. LTD                    | NEW DELHI |         |
|         |                             | TORRENT CABLES LTD                        | AHMEDABAD |         |
|         |                             | THERMO CABLES LTD                         | HYDERABAD |         |
|         |                             | TIRUPATI PLASTOMATICS PVT. LTD            | JAIPUR    |         |
| 20.     | XLPE CONTROL CABLES         | APAR INDUSTRIES LTD                       | MUMBAI    |         |
|         |                             | CABLE CORPORATION OF INDIA LTD            | MUMBAI    |         |
|         |                             | CRYSTAL CABLE INDUSTRIES LTD              | KOLKATA   |         |
|         |                             | DIAMOND POWER INFRASTRUCTURE LTD          | VADODARA  |         |
|         |                             | GEMSCAB INDUSTRIES LTD                    | NEW DELHI |         |
|         |                             | HAVELLS INDIA LIMITED                     | NOIDA     |         |
|         |                             | KEI INDUSTRIES LTD                        | NEW DELHI |         |
|         |                             | KRISHNA ELECTRICAL INDUSTRIES LTD         | GWALIOR   |         |
|         |                             | KEC INTERNATIONAL LIMITED                 | MUMBAI    |         |
|         |                             | PARAMOUNT COMMUNICATIONS LTD              | NEW DELHI |         |
|         |                             | POLYCAB WIRES PVT. LTD                    | MUMBAI    |         |
|         |                             | RADIANT CORPORATION PRIVATE LIMITED       | HYDERABAD |         |
|         |                             | RAVIN CABLES LIMITED                      | MUMBAI    |         |
|         |                             | SUYOG ELECTRICALS LTD                     | VADODARA  |         |
|         |                             | SRIRAM CABLES PVT. LTD                    | NEW DELHI |         |
|         |                             | TORRENT CABLES LTD                        | AHMEDABAD |         |
|         |                             | UNIVERSAL CABLES LTD                      | SATNA     |         |
| 21.     | CABLE GLAND                 | COMMET                                    |           |         |
|         |                             | SUNIL&CO                                  |           |         |
|         |                             | ARUP ENGINEERING                          |           |         |
|         |                             | JAINSON                                   |           |         |
|         |                             | DOWELL                                    |           |         |
| 22.     | PUSH BUTTONS                | SIEMENS                                   |           |         |
|         |                             | L&T                                       |           |         |
|         |                             | BCH                                       |           |         |
|         |                             | SCHNEIDER                                 |           |         |
| 23.     | LIMIT SWITCHES              | SPEED-O-CONTROL                           |           |         |
|         |                             | ELECTROMAG                                |           |         |
| 24.     | PENDENT PUSH BUTTON STATION | OEM                                       |           |         |
| 25.     | INDICATING LAMPS            | TECKNIC                                   |           |         |
|         |                             | BCH                                       |           |         |
|         |                             | SIEMENS                                   |           |         |

| SR. NO. | ITEM             | SUPPLIERS                            | PLACE | REMARKS                               |
|---------|------------------|--------------------------------------|-------|---------------------------------------|
|         |                  | STANDARD                             |       |                                       |
| 26.     | MCB              | MDS                                  |       |                                       |
|         |                  | INDO COPP                            |       |                                       |
|         |                  | STANDARD                             |       |                                       |
|         |                  | SIEMENS                              |       |                                       |
|         |                  | L&T                                  |       |                                       |
|         |                  | ABB                                  |       |                                       |
|         |                  | SCHNEIDER                            |       |                                       |
| 27.     | PANELS           | OEM                                  |       |                                       |
|         |                  | RITTAL                               |       |                                       |
|         |                  | PYROTECH                             |       |                                       |
| 28.     | RESISTANCE BOXES | ENAPROS                              |       |                                       |
|         |                  | OEM                                  |       |                                       |
|         |                  | SAFEX FIRE SERVICES LTD              |       |                                       |
|         |                  | UNITED FIRE EQUIPMENTS PVT. LTD      |       |                                       |
|         |                  | ZENITH FIRE SERVICES (INDIA) PVT LTD |       |                                       |
| 29.     | VVVF             | YASKAWA                              |       |                                       |
|         |                  | ABB                                  |       |                                       |
|         |                  | SIEMENS                              |       |                                       |
|         |                  | SCHNIEDER                            |       |                                       |
|         |                  | FUJI ELECTRIC                        |       |                                       |
|         |                  | MITSUBISHI ELECTRIC                  |       |                                       |
| 30.     | SHROUDED DSL     | SUSHEEL                              |       |                                       |
|         |                  | STROMAG                              |       |                                       |
| 31.     | LOAD CELL        | IPA                                  |       |                                       |
|         |                  | SARTORIUS                            |       |                                       |
| 32.     | GEAR BOX         | OEM                                  |       | * = Applicable for Geared Motors only |
|         |                  | ELECON ENGINEERS                     |       |                                       |
|         |                  | SHANTI GEARS                         |       |                                       |
|         |                  | PBL*                                 |       |                                       |
|         |                  | NAW*                                 |       |                                       |
|         |                  | NORD*                                |       |                                       |
|         |                  | SEW*                                 |       |                                       |
|         |                  | BONGFILIOLI*                         |       |                                       |

**NOTE:**

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

*Anshul*  
Anshul

*S A Khan*  
S A Khan

*Praveen Kishore*  
Praveen Kishore

2. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

**MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO CHAIN PULLEY BLOCKS:**

| <b>SR. NO.</b> | <b>ITEM</b>  | <b>SUPPLIERS</b>           | <b>PLACE</b> | <b>REMARKS</b>     |
|----------------|--------------|----------------------------|--------------|--------------------|
| <b>33.</b>     | <b>STEEL</b> | SAIL                       |              |                    |
|                |              | TISCO                      |              |                    |
|                |              | JINDAL                     |              |                    |
|                |              | ESSAR                      |              |                    |
| <b>34.</b>     | <b>HOOKS</b> | STEEL FORGING & ENGG. CO., | KOLKATA      |                    |
|                |              | SIMRITI FORGING            |              |                    |
|                |              | KARACHIWALA                |              | UP TO 25T CAPACITY |
|                |              | NASHIK FORGE               |              |                    |

**NOTE:**

4. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

5. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.
6. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.



**TITLE:**  
**ELECTRICAL EQUIPMENT SPECIFICATION**  
**FOR EOT CRANES / ELEVATORS / ELECTRIC HOISTS**  
**SYSTEM**  
**(ELECTRICAL PORTION)**  
**2X660 MW ENNORE TPS**

**SPECIFICATION NO.**  
PE-TS-323-A001  
**VOLUME NO. :** II-B  
**SECTION:** C  
**REV NO. :** 0 **DATE:** 31.01.17  
**SHEET:** 1 OF 2

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

The equipment and services to be provided by bidder under this specification shall be as detailed here below but shall not be limited to the following:

- a) Services and Equipment as per "Electrical Scope between BHEL and Vendor".
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Erection and Commissioning spares.
- e) Erection & Maintenance tools & tackles.
- f) Electrical load requirement for EOT CRANES / ELEVATORS / ELECTRIC HOISTS System.
- g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer / BHEL approval without any commercial and delivery implications to BHEL.
- i) Various drawings including GA drg, data sheet as per required format, quality plans, calculations, test reports, test certificates, operation and maintenance manuals, characteristic curves, wiring diagrams/schemes etc shall be furnished as specified at contract stage. All documents shall be subject to customer / BHEL approval without any commercial implications to BHEL.
- j) Motors shall meet minimum requirement of Electric motor specification.
- k) All routine tests and type tests reports as per applicable standards shall be furnished at contract stage.
- l) Purchaser will furnish data sheets to the vendor after award of contract. Vendor shall furnish filled in data sheets meeting the specification requirements.
- m) LV Power Cables and Control Cables shall be as per cable annexure.
- n) Cable trays shall be as per attached Cable Tray Annexure.
- o) Panel shall be as per attached Panel Annexure.
- p) Technical requirements shall be as per specifications listed in Clause 4.1 to 4.9. In case of any discrepancy between Basic technical Particulars for HT or LT motors and BHEL standard specification, Basic technical particulars for HT or LT motors shall prevail.

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

Refer "Electrical Scope between BHEL and Vendor".

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

**3.1** Bidder shall confirm total compliance to the electrical specification without any deviation from the technical / quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:

- a) A copy of this sheet "Electrical Equipment Specification for EOT CRANES / ELEVATORS / ELECTRIC HOISTS System and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
- b) List of Erection and Commissioning spares.
- c) List of Erection & Maintenance tools & tackles.



**TITLE:**  
**ELECTRICAL EQUIPMENT SPECIFICATION**  
**FOR EOT CRANES / ELEVATORS / ELECTRIC HOISTS**  
**SYSTEM**  
**(ELECTRICAL PORTION)**  
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SHEET: 1 OF 2

- d) Electrical load requirement.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 **LIST OF ENCLOSURES**

- 4.1 Electrical scope between BHEL & vendor.
- 4.2 Technical specification – Specification for Electric Motors/Actuators
- 4.3 Basic Technical Particulars of HT/LT motors.
- 4.4 Testing Requirements.
- 4.5 Quality Plan for LV Motors.
- 4.6 Load Data Format.

## STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: SINGLE GIRDER EOT CRANES &amp; ELECTRIC HOISTS

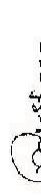
SCOPE OF VENDOR: SUPPLY

PROJECT :

| <u>S. NO</u> | <u>DETAILS</u>                                                                                                                   | <u>SCOPE SUPPLY</u>        | <u>SCOPE E&amp;C</u> | <u>REMARKS</u>                                                                                                                                                                                                                                |
|--------------|----------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1            | Isolating Switch                                                                                                                 | Vendor                     | BHEL                 | BHEL will provide one number 415 V(3ph, 4W) supply feeder only up to isolating switches for cranes/hoists. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane/ hoist control panel. |
| 2            | Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor. | Vendor                     | BHEL                 | Cable from supply feeder to isolating switch shall be in BHEL scope.                                                                                                                                                                          |
| 3            | Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).                                         | Vendor                     | BHEL                 |                                                                                                                                                                                                                                               |
| 4            | Equipment Earthing                                                                                                               | BHEL                       | BHEL                 | All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL                                                                               |
| 5            | Motors                                                                                                                           | Vendor                     | BHEL                 |                                                                                                                                                                                                                                               |
| 6            | Cable glands and lugs for equipment supplied by vendor                                                                           | Vendor                     | BHEL                 | 1. Double compression Ni-Cr plated brass cable glands<br>2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.                                                                                               |
| 7            | a) Input cable schedules (C & I)<br>b) Cable interconnection details for above<br>c) Cable block diagram                         | Vendor<br>Vendor<br>Vendor | -<br>-<br>-          | Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.                                                                                                  |
| 8            | Equipment layout drawings                                                                                                        | Vendor                     | -                    |                                                                                                                                                                                                                                               |
| 9            | Electrical Equipment GA drawing                                                                                                  | Vendor                     | -                    | For necessary interface review.                                                                                                                                                                                                               |

  
 Anshul

  
 S. A. Khan

  
 Praveen K. Gore

|  |                                                                                            |                                                                                                                                    |
|--|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
|  | TITLE :<br><b>GENERAL TECHNICAL REQUIREMENTS</b><br><br><b>FOR</b><br><br><b>LV MOTORS</b> | SPECIFICATION NO.<br>PE-SS-999-506-E101<br>VOLUME NO. : <b>II-B</b><br><br>REV NO. : <b>00</b> DATE : 29/08/2005<br>SHEET : 1 OF 1 |
|--|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|

# **GENERAL TECHNICAL REQUIREMENTS**

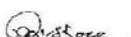
**FOR**

**LV MOTORS**

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

  
Anshul

  
S A Khan

  
Pawan Kishore

|                                                                                  |                                                                                                   |                                         |
|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------|
|  | <b>TITLE :</b><br><b>GENERAL TECHNICAL REQUIREMENTS</b><br><br><b>FOR</b><br><br><b>LV MOTORS</b> | SPECIFICATION NO.<br>PE-SS-999-506-E101 |
|                                                                                  |                                                                                                   | VOLUME NO. : <b>II-B</b>                |
|                                                                                  |                                                                                                   | SECTION : <b>D</b>                      |
|                                                                                  |                                                                                                   | REV NO. : <b>00</b> DATE : 29/08/2005   |
|                                                                                  |                                                                                                   | SHEET : 1 OF 4                          |

## 1.0 INTENT OF SPECIFICATION

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

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

## 2.0 CODES AND STANDARDS

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

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

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

## 3.0 DESIGN REQUIREMENTS

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

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

### 3.3 Starting Requirements

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

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

|                                                                                  |                                                                                                   |                                         |
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|                                                                                  |                                                                                                   | VOLUME NO. : <b>II-B</b>                |
|                                                                                  |                                                                                                   | SECTION : <b>D</b>                      |
|                                                                                  |                                                                                                   | REV NO. : <b>00</b> DATE : 29/08/2005   |
|                                                                                  |                                                                                                   | SHEET : 2 OF 4                          |

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

### 3.3.3 The following frequency of starts shall apply

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

### 3.4 Running Requirements

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

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

### 3.5 Stress During bus Transfer

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

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

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

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

### 4.0 CONSTRUCTIONAL FEATURES

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

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

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

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

|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                         |
|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
|  | TITLE :<br><b>GENERAL TECHNICAL REQUIREMENTS</b><br><br><b>FOR</b><br><br><b>LV MOTORS</b>                                                                                                                                                                                                                                                                                                                                                                             | SPECIFICATION NO.<br>PE-SS-999-506-E101 |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | VOLUME NO. : <b>II-B</b>                |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | SECTION : <b>D</b>                      |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | REV NO. : <b>00</b> DATE : 29/08/2005   |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | SHEET : 3 OF 4                          |
| 4.4.                                                                             | Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.                                                                                                                                                                                                                                                                                                                                                              |                                         |
| 4.5                                                                              | Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.                                                                                                                                                                                                                                                                                                                          |                                         |
| 4.6                                                                              | In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation.<br>In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.                                                                                                                                                                     |                                         |
| 4.7                                                                              | <b>Terminals and Terminal Boxes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                         |
| 4.7.1                                                                            | Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.<br><br>Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”. |                                         |
| 4.7.2                                                                            | unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.                                                                                                                                                                                                                                                                                         |                                         |
| 4.7.3                                                                            | Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.                                                                                                   |                                         |
| 4.7.4                                                                            | Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.                                                                                                                                                                                                                                             |                                         |
| 4.7.5                                                                            | Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.                                                                                                                                                                                                                                |                                         |
| 4.7.6                                                                            | Degree of protection for terminal boxes shall be IP 55 as per IS 4691.                                                                                                                                                                                                                                                                                                                                                                                                 |                                         |
| 4.7.7                                                                            | Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.                                                                                                                                              |                                         |
| 4.7.8.                                                                           | Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.                                                                                                                                                                                                                                                                                                                                                                 |                                         |
| 4.7.9                                                                            | Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.                                                                                                                                                                                                                                                                                                                       |                                         |
| 4.8                                                                              | Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.                                                                                                                                                                                                                                      |                                         |
| 4.9                                                                              | <b>General</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                         |

|                                                                                  |                                                                                                   |                                         |
|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------|
|  | <b>TITLE :</b><br><b>GENERAL TECHNICAL REQUIREMENTS</b><br><br><b>FOR</b><br><br><b>LV MOTORS</b> | SPECIFICATION NO.<br>PE-SS-999-506-E101 |
|                                                                                  |                                                                                                   | VOLUME NO. : <b>II-B</b>                |
|                                                                                  |                                                                                                   | SECTION : <b>D</b>                      |
|                                                                                  |                                                                                                   | REV NO. : <b>00</b> DATE : 29/08/2005   |
|                                                                                  |                                                                                                   | SHEET : 4 OF 4                          |

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

## 5.0 INSPECTION AND TESTING

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

## 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

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

# BASIC TECHNICAL FEATURES

## FOR HT/LT MOTORS

### (FOR BHEL-PEM SCOPE PACKAGES)

|                                                   |          |         |        |        |                                                                                     |                                                                                     |                                                                                               |                                |      |          |          |                 |
|---------------------------------------------------|----------|---------|--------|--------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------|------|----------|----------|-----------------|
|                                                   |          |         |        |        | PROJECT                                                                             | 2X660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS,CHENNAI |                                                                                               |                                |      |          |          |                 |
| REV                                               | DATE     | ALTD    | CHD    | APPD   |  | OWNER                                                                               | TAMIL NADU GENERATION & DISTRIBUTION CORPOARATION LIMITED                                     |                                |      |          |          |                 |
| 02                                                | 13.05.15 | RKG/AB  | SL     | RG     |                                                                                     |                                                                                     |                                                                                               |                                |      |          |          |                 |
| REVISED AS PER TANGEDCO COMMENTS DATED 10.04.2015 |          |         |        |        |  | OWNER'S CONSULTANT                                                                  | DESEIN PRIVATE LIMITED, DESEIN HOUSE,NEW DELHI                                                |                                |      |          |          |                 |
| REV                                               | DATE     | ALTD    | CHD    | APPD   |  | EPC CONTRACTOR                                                                      | BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA |                                |      |          |          |                 |
| 01                                                | 13.03.15 | BKR-SD- | SL-SD- | RG-SD- |                                                                                     |                                                                                     |                                                                                               |                                |      |          |          |                 |
| REVISED AS PER TANGEDCO COMMENTS DATED 13.02.2015 |          |         |        |        |  | BHARAT HEAVY ELECTRICALS LTD. POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA     |                                                                                               | DEPT CODE                      | DRN  | NAME BKR | SIGN     | DATE            |
| TITLE                                             |          |         |        |        |                                                                                     | BASIC TECHNICAL FEATURES FOR HT/LT MOTORS                                           |                                                                                               | E                              | DSGN | BKR      | -SD-     | 13.01.15        |
|                                                   |          |         |        |        |                                                                                     |                                                                                     |                                                                                               | CHD                            | SL   | -SD-     | 13.01.15 |                 |
|                                                   |          |         |        |        |                                                                                     |                                                                                     |                                                                                               | APPD                           | RG   | -SD-     | 13.01.15 |                 |
|                                                   |          |         |        |        |                                                                                     |                                                                                     |                                                                                               | DRAWING NO. PE-DC-412-565-E003 |      |          |          |                 |
|                                                   |          |         |        |        |                                                                                     |                                                                                     |                                                                                               | SHEET                          | 1    | OF       | 7        | Page 492 of 697 |
|                                                   |          |         |        |        |                                                                                     |                                                                                     |                                                                                               |                                |      |          |          |                 |



**2 x 660 MW ENNORE SEZ STPP**

**BASIC TECHNICAL FEATURES  
FOR HT / LT MOTORS  
(FOR BHEL-PEM SCOPE PACKAGES)**

|          |                    |
|----------|--------------------|
| Doc. No. | PE-DC-412-565-E003 |
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1.0 This document covers the basic technical features of high tension (HT) and low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in **2 x 660 MW ENNORE SEZ STPP**.

2.0 CODES AND STANDARDS

**The motors shall generally conform to IS 325/IEC-60034. LT motors above 10 kW with continuous duty (S1) shall be energy efficient IE2 conforming to IS-12615: 2011.**

3.0 DESIGN REQUIREMENTS

3.1 General Requirements

The design ambient temperature shall be 50 deg C.

3.2 Supply system and rated voltage of motors

| KW rating                              | Supply system | Rated voltage of motor |
|----------------------------------------|---------------|------------------------|
| Above 1500 kW                          | 11 KV         | 11 KV                  |
| Above 160 kW up to & including 1500 kW | 3.3 KV        | 3.3 KV                 |
| From 200W up to & including 160 kW     | 415 V         | 415 V                  |
| Below 200W                             | 240V          | 240V                   |

3.2.1 Supply voltage & variations shall be as follows:-

Voltage variation (AC Supply) (+/-) 10%  
Frequency variation (+) 3% to (-) 5%  
Combined V & F variation 10% (sum of absolute values)

3.2.2 Motors shall be capable of running continuously at rated output for each of the conditions specified.

3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the drive equipment. Motors shall be continuously rated at the design ambient temperature of 50 degree C and relative humidity of 85%. Maximum continuous motor ratings shall have at least a 10% margin above the maximum load demand of the driven equipment under entire operating range including voltage & frequency variation.

3.4 Starting Requirements

3.4.1 Motor shall start smoothly and rapidly. Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% of the motor's full load torque.

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

Minimum Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

- 3.4.3 The locked rotor current of the HV (11 kV) motors (except MDBFP motors) shall not exceed 650% of full load current inclusive of tolerance as per IS: 325 and for MV (3.3 kV) motors locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.

- 3.4.4 The following frequency of starts shall apply to HV (11 kV), MV (3.3 kV) & LT motors

- i) Two nos. consecutive cold starts in quick succession with third start after 5 minutes in cold condition.
- ii) Two nos. consecutive hot starts in the interval of 15 minutes in hot condition.

- 3.4.5 Locked motor withstand time of motors under hot condition at highest voltage limit shall be as follows:

- a) For motors with starting time up to 20 sec.
  - at least 2.5 sec. more than starting time.
- b) For motor with starting time above 20 secs but not exceeding 45 secs.
  - at least 5.0 sec. more than starting time.
- c) For motors with starting time above 45 secs.
  - at least 10% more than starting time.

The starting time of the motor referred above is at minimum permissible voltage. For motors and in cases where the above requirements are not complied with, speed switches of approved make & type shall be provided to bypass the locked rotor protection for a pre-selected time during starting of motors. The speed switches shall have one NO & one NC contacts having maximum interrupting capacity of 5 Amps at 240V AC and 0.25 amps at 220 V DC.

### 3.5 Running Requirements

- 3.5.1 Motors shall run satisfactorily at a supply voltage of 80% of rated voltage for 5 minutes with full load without injurious heating to the motor.

- 3.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

### 3.6 Stress during bus Transfer:

Anshul

S A Khan

Praveen Kumar

|                                                                                   |                                                                                                                                   |          |                    |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------|--------------------|
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3.6.1 Motors shall withstand the voltage and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.6.2 Motor windings shall be adequately braced to satisfactorily withstand the mech. Stresses during above condition.

3.6.3 Motors shall be capable of withstanding heavy in-rush transient current caused by bus transfer without damage.

3.6.4 Motor and driven eqpt. Shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.7 Noise level

The maximum noise level for motors shall be in line with IS 12065.

3.8 Vibration

The maximum vibration for motors shall be in line with IS: 12075.

**3.9 Crane duty motors will be of squirrel cage induction motor and shall suit the duty class S4, cyclic duration factor 40% and 300 starts. Crane duty motors shall be provided with VVFD for speed control.**

1

4.0 CONSTRUCTIONAL FEATURES

4.1 Degree of Protection

4.1.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Canopy shall be provided for outdoor motors. CW motors (in case of screen prot. Drip proof) shall conform to degree of protection IP: 23 as per IS: 4691. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.

4.1.2 The stator laminations shall made from suitable silicon steel/magnetic steel sheet varnished on both sides and pressed to form a rigid core.

4.1.3 The rotor shall be of rigid cage construction with die cast aluminium / copper alloy / copper bars firmly wedged in bar slots and brazed to the end rings. The rotor cage shall be designed to operate satisfactorily under respective starting and load duty cycle.

4.2 Enclosure and Cooling

4.2.1 Motors shall generally have totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) enclosures or Closed Air circuit Air (CACA), the method of cooling conforming to IC-0141 or IC-0151 or IC-0161 of IS: 6362 up to 3000 kW motor. CW Motors may be screen protected drip proof (SPDP).

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

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

#### 4.3 Class of Insulation

HV/MV/LT motors shall have class F insulation. The temperature rise of all motors shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits, 10deg C rise above the temperature limits specified in IS: 325 shall be permissible.

#### 4.4 Bearings

4.4.1 Horizontally mounted motors shall have grease lubricated ball/roller or sleeve bearings. For HV/MV motors, the bearings shall be regreasable type and for LV motors, these bearings can be either sealed life lubricated type or regreasable type as per manufacturer's standard.

4.4.2 The vertical motors shall have a combined thrust and guide bearing on top and guide bearing at bottom. If the ball or roller bearings can take vertical thrust, thrust and guide bearing need not be provided.

4.4.3 After taking all motor driven equipment loads and thrust (if any) into account, the bearings shall be suitable for min. 20,000 working hours. Re-greasable bearings shall be provided with grease nipples and relief holes for on-line re-greasing and shall be suitable for 8000 working hours without changing of the grease.

4.4.4 The bearings of solidly coupled motors shall be of the same type as those of the driven equipment.

4.4.5 For motors below 15 kW shall be provided with sealed ZZ bearing.

4.4.6 Motors rated above 1000kW shall be provided with insulated end shield on non-driving end to prevent flow of shaft current.

#### 4.5 Terminals and Terminal Boxes

4.5.1 Motors of rating 90 kW and up to 160kW will be controlled by air circuit breaker with numerical protection. For all motors of rating up to 90kW shall be provided with MCCBs. The terminal box of motors for HV (11 kV), MV (3.3 kV) & LT motors shall be designed for the maximum fault current for a duration of at least 0.25 secs. **11kV & 3.3kV motors terminals shall be able to withstand 44kA for 0.25 seconds.**

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

4.5.3 For HV/MV motors, the main terminal box shall be of phase-segregated type with clamping arrangement for the terminals.

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

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



**2 x 660 MW ENNORE SEZ STPP**  
**BASIC TECHNICAL FEATURES**  
**FOR HT / LT MOTORS**  
**(FOR BHEL-PEM SCOPE PACKAGES)**

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- 4.5.6 Motor terminals and terminal leads shall be fully insulated with no bar live parts.
- 4.5.7 Separate terminal boxes shall be provided for space heaters and temp. Indicators. If this is not possible in case of LT motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material for single core cables) with double compression tinned brass glands shall be provided in terminal boxes.
- 4.5.8 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 180 and 90 degree for HT and LT motors respectively.
- 4.5.9 Cable glands and cable lugs as per selected cable sizes shall be provided in line with cable erection philosophy. For single core cable termination, gland plates shall be of non-magnetic material.
- 4.6 Grounding

Two separate earthing terminals suitable for connecting G.I. strip grounding conductor shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.7 General

- 4.7.1 Motors provided for similar drives shall be interchangeable.
- 4.7.2 An arrow block shall be screwed on the body of the motors on the non-driving end to indicate the direction of rotation of the motors.
- 4.7.3 Motors for Fuel oil unloading and drain oil pumps located in hazardous areas shall be with flame-proof enclosures in accordance with IS 2148 / IEC 60079.

a) Fuel oil area: Group - IIB.

b) Hydrogen generation plant area: Group - IIC

- 4.8 Neutral terminal box of motors rated 1000kW and above shall provision of mounting Neutral CTs of PS class identical to the CTs to be provided at switchgear end. Further the neutral terminals of HV motors rated below 1000kW shall be accessible.

1

5.0 ACCESSORIES

5.1 SPACE HEATERS

All motors rated 30KW and above shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

The leads from space heaters of each motor shall be brought out to a separate terminal Box. Space heaters shall be mounted inside the motor in accessible places so that their removal and replacement is simple.

5.2 RESISTANCE TEMPERATURE DETECTORS (RTDs)

- 5.2.1 HV/MV motors stator windings shall be provided with 12 nos. Simplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of winding temperature. The leads from RTDs of each motor shall be brought out to a separate terminal Box.

|                                                                                   |                                                                                                                                   |          |                    |
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5.2.2 For HV/MV motors, each bearing shall be provided with 1 no. Duplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of bearing temperature. The leads from these RTDs shall be brought out to a separate terminal Box or the terminal box same as for winding RTDs.

### 5.3 DIAL TYPE TEMP. INDICATORS

5.3.1 For HV/MV motors, each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. The indicators shall have 2 nos. NO contacts rated for 5A, 240 V AC and 0.5 A, 220 V DC for alarm/trip purpose.

### 5.4 Vibration monitoring pads

5.4.1 Provision shall be made in all HV/MV motors for mounting vibration detectors.

### 6.0 NAME PLATE

Motors shall have stainless steel name plate with all particulars as per IS: 325. In addition bearing identification number and type of lubricant is to be indicated.

### 7.0 PAINTING

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL 7032).

### 8.0 TESTING

#### 8.1 Type Tests

For HT & LT Motors, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.

#### 8.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.

## CHAPTER – 12

### MOTORS

#### 1.00.00 DESIGN CRITERIA

1.00.01 For the purpose of design of equipments /systems, an ambient temperature of 50 °C and relative humidity of 85% shall be considered. The equipment shall operate in a highly polluted environment.

1.00.02 Transient voltage dip on starting of the largest motor with DOL shall be limited to 20% of the nominal system voltage at the voltage terminals.

#### 1.00.03 Rating

The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency.

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

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

1.00.04 Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

For Mill Motors:

1. 85 % of rated voltage for motors above 1000 kW
2. 90 % of rated voltage for motors up to 1000 kW

1.00.05 Canopy shall be provided for outdoor motors.

1.01.00 Contractor shall provide fully compatible electrical system, equipments, accessories and services.

1.02.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

**1.03.00 Voltage and frequency variations:**

Frequency: (+) 3% and (-) 5%

Voltage : **i. AC**

a.  $\pm 6\%$  for 11 kV/3.3 kV

b.  $\pm 10\%$  for 415 V

Combined 10 % (absolute sum)

**ii. DC-** +10% to -15% for 220 V DC

1.04.00 All LV motors above 10 kW with S1 duty shall be compulsorily of Energy efficient level IE 2 as per IS 12615: 2011.

1.05.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.

**1.06.00 Type**

AC Motors:

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

(b.) Crane duty motors shall be slip ring type induction motor

DC Motors

(a.) Shunt wound.

**1.07.00 Temperature Rise**

**Air cooled motors**

70°C by resistance method

**Water cooled**

80° C over inlet cooling water temperature mentioned elsewhere, by resistance method.

**1.08.00 Degree of Protection**

Degree of protection for various enclosures shall be as follows :

i) Indoor motors — IP 54

- |      |                                                |   |       |
|------|------------------------------------------------|---|-------|
| ii)  | Outdoor motors                                 | – | IP 55 |
| iii) | CW motors (in case of screen prot. Drip proof) | – | IP 23 |
| iv)  | Cable box – indoor area                        | – | IP 54 |
| v)   | Cable box – outdoor area                       | – | IP 55 |

## **2.00.00 CODES AND STANDARDS**

2.01.00 All motors shall confirm to the latest editions including all applicable amendment of relevant IS, IEC and CBIP standards/Publications. In case any other standard is followed that ensures equal or better quality, may be accepted. However the English version of the Standard adopted shall be submitted.

2.02.00 Major Standards, which shall be followed, are listed below. Any other applicable Indian standards for any component part even if not covered in the list shall also be followed

- |     |                                                                     |   |                                              |
|-----|---------------------------------------------------------------------|---|----------------------------------------------|
| 1.) | Three phase induction motors                                        | : | IS:325, IEC:60034                            |
| 2.) | Single phase AC motors                                              | : | IS:996, IEC:60034                            |
| 3.) | Crane duty motors                                                   | : | IS:3177, IEC:60034                           |
| 4.) | DC motors/generators                                                | : | IS:4722                                      |
| 5.) | Degree of protection by enclosures for rotating electrical machines | : | IS: 4691<br>IS: 4728<br>IS: 6362<br>IS: 2253 |
| 6.) | Noise levels for rotating electrical machines                       | : | IS: 12065                                    |
|     | Mechanical Vibrations for rotating electrical machines              | : | IS: 12075                                    |

## **3.00.00 OPERATIONAL REQUIREMENTS**

3.01.00 Starting Time

3.01.01 For motors with starting time up to 20 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs more than starting time .

- 3.01.02 For motors with starting time more than 20 secs and up to 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs more than starting time.
- 3.01.03 For motors with starting time more than 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
- 3.01.04 Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
- 3.01.05 Motors shall be capable of restarting under full load after a momentary loss of voltage with the possibility of 150 % nominal voltage during fast bus transfer.
- 3.02.00 Torque Requirements
- 3.02.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
- 3.02.02 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

#### **4.00.00 DESIGN AND CONSTRUCTIONAL FEATURES**

- 4.00.01 Suitable single phase space heaters shall be provided on motors rated 30 kW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.
- 4.00.02 All motors shall be suitable for direct on line starting through any type of breaker.
- L All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below

- (a) Fuel oil area : Group - IIB
- (b) Hydrogen generation plant Group - IIC  
area :

#### **4.00.03 Winding and Insulation**

- (a) Type : Non-hygroscopic, oil resistant, flame resistant

- (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature
- (c) 11 kV / 3.3 kV AC motors : Class F: with winding temperature rise limited to class B. They shall withstand 1.2/50 micro sec switching surges of  $4U+5$  KV (U=Line voltage in KV). The coil inter-turn insulation shall be suitable for 0.3/3 micro sec. surge of 32 KVp and 12 kVp for 11 kV and 3.3 kV system respectively followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.
- (d) 415V AC & 220V DC motors : Class 'F' with temperature rise limited to class 'B'

- 4.00.04 Motors rated above 1000 kW shall have insulated bearings to prevent flow of shaft currents.
- 4.00.05 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
- 4.00.06 Noise level and vibration shall be limited within the limits prescribed in IS: 12065 & IS: 12075 respectively. Motors shall withstand vibrations produced by driven equipment.
- 4.00.07 In MV/HV motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0°C, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the ETD's shall be platinum. Each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. All HV motors shall be provided with shaft grounding rings for bearing protection and earthing shaft current.
- 4.00.08 MV/HV motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage and shall be capable of either two starts in quick succession with third start after 5 minutes in cold condition or two starts at 15 minutes intervals in hot condition, both cases with voltage and frequency variation within specified limits.
- 4.00.09 Locked rotor current of the MV motors shall be limited to 600% (subject to IS tolerance) of the full load current of the motors and for HV motor shall be limited to 450% (inclusive of IS tolerance) of full load current of the motor.

Locked rotor current of the LV motor shall not exceed 600% of full load current inclusive of IS tolerance.

- 4.00.10 MV Motors shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. These differential protection CTs shall be supplied loose by 11/ 3.3 kV switchgear manufacturer.
- 4.00.11 Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.
- 4.00.12 HV motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
- 4.00.13 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
- 4.00.14 The motors shall be suitable for bus transfer schemes provided on the 11 kV, 3.3 kV/415V systems without any injurious effect on its life.
- 4.00.15 All motors below 15 kW shall be provided with sealed ZZ bearings.
- 4.00.16 For motors rated 1000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
- 4.00.17 All motors shall be provided with an emergency stop push button near the motor as per the Indian Statutory regulations.
- 4.00.18 The motor terminal box shall be suitable for withstanding the maximum system fault current for a duration of at least 0.25 seconds.
- 4.00.19 Neutral in case of HV motors shall be kept accessible.

- 4.00.20 Motors shall be designed to easy access for drilling holes through motor feed of mounting flange for installation of dowel pins after assembly of the motor and driven equipment.
- 4.00.21 Well spacious working platforms shall be provided around the motor area for carrying out maintenance & testing works. Platform shall be minimum of 300 mm below the level of motor base plate.
- 4.00.22 Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
- 4.00.23 For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box..
- 4.00.24 Lube oil pressure transmitters shall be provided to DCS for remote monitoring. Lube oil pressure very low trip to HV equipment shall be 2 out of 3 logic.
- 4.00.25 Capillary type temperature gauge cum switch shall be provided for DE / NDE of HV Motors
- 4.00.26 Motors with CACA/CACW heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following:

-Hot and cold air temperatures of the closed air circuit for CACA motors.

-Hot and cold, air and water temperatures for CACW motors.

The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.

#### **4.00.27 Lifting Provisions**

Motor weighing 25 kg or more shall be provided with eye bolt or other adequate provision for shifting. Electrical hoists shall be provided for motors above 1000 kgs for maintenance of the same.

#### **4.00.28 DC MOTORS**

DC motors shall be provided where specified/required. DC Motors shall be sized for operation with fixed resistance starting for reliability. DC motors shall be shunt wound type. Motors shall be capable of delivering the rated output at 220 V DC with (+) 10% and (-) 15% variations without exceeding its guaranteed temperature limits. 220 V DC

system shall be unearthed. Starting current of the DC motors shall be limited to 200% of the full load current of the motor, and is subject to IS tolerance. DC Motors shall be similar to AC Motors with respect to other features like enclosure type, cooling and class of insulation

#### **4.00.30 Painting**

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL 7032).

#### **4.00.31 Local Push Button Stations**

The LPBS shall be installed near the motors to be controlled. Individual channel supports shall be used for each LPBS. These shall be installed as per approved erection detail drawing. LPBS for hazardous areas shall be CMRS certified and CCE approved.

All LPBS shall have necessary canopies. Wiring of LPBS shall be checked before giving control supply.

### **5.00.00 LIST OF TESTS TO BE CONDUCTED FOR HV, MV and LV MOTORS**

#### **5.01.00 TYPE TESTS**

- (a) No load saturation and loss curves up to approximately 115% of rated voltage
- (b) Momentary overload test
- (c) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temperature shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.
- (d) Surge withstand test on the sample coil after placing it in stator core at  $(4U + 5 \text{ KV})$  and with at least five impulse of 1.2/50 micro sec. wave, for HV motors only, where U is the line to line voltage in kV.
- (e) Surge-withstand test with 0.3/3 micro sec. wave on each type of 3.3/11 kV motor coils with at least five such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out

the turns suitably. The power frequency test voltage shall be decided during detailed engineering.

- f) Dimensions (for motors covered by IS 1231:1974 and IS 2223:1983 only)
- g) Measurement of resistance of windings of stator and wound rotor.
- h) Reduced voltage running up test at no load (for squirrel cage motors up to 37kw only)
- i) Full load test to determine efficiency, power factor and slip.
- j) Insulation resistance test
- k) Test for vibration severity of motor
- l) Test for noise levels of motor
- m) Test for degree of protection by enclosure
- n) Temperature rise test at limiting values of voltage and frequency variations
- o) Over speed test

#### **5.02.00 ROUTINE TESTS**

The following shall constitute the routine tests.

- a) Insulation resistance test
- b) Measurement of resistance of windings of stator and wound rotor.
- c) No load test
- d) Locked rotor readings of voltage, current and power input at a suitable reduced voltage
- e) Reduced voltage running up test ( for squirrel cage motor)
- f) Open circuit voltage ratio of stator and rotor windings (for slip ring motors); rotor;
- g) High voltage test

#### **6.00.00 INSPECTION AND TESTING AT SITE**

6.01.01 Insulation resistance of 415V motors shall be measured between the winding of the machine and its frame by means of a 500/1000V megger. A minimum value of 1 mega ohm for 415V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be brought up by any of the following methods as desired by the Site Engineer:

- (a.) Blowing hot air in case of big motors.
- (b.) Putting the motor in electric oven in case of smaller motors.
- (c.) Placing heaters or lamps around and inside in case of small motors after making suitable guarding and covering arrangements so as to conserve the heat.

6.01.02            Site Test

- (a.) Measurement of vibration.
- (b.) Measurement of insulation resistance and polarization index.
- (c.) Measurement of full load current.
- (d.) Test running of the motors, checking the temperature rise and identifying the hot spot etc.

6.01.03            3.3 kV motors shall be tested for insulation by 500/1000V megger and its value should not be less than the safe minimum insulation of  $\geq 20 \text{ M}\Omega$  resistance at 60 deg. C. In case the insulation is low, the following method of drying has to be adopted:

- a.    By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals that full load current flows in the stator, keeping the stator winding temperature below 90 deg. C. In this a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. Value becomes steady.
- b.    By blasting hot air from external source, Maximum temperature of winding while drying should be 70 deg. C to 80 deg. C. (Thermometer) or 90 deg. C. to 95 deg. C. by resistance method. Heating should be done slowly till steady temperature of winding is reached after 4 to 5 hours and for large machines after 10 hours. A record has to be kept for drying process, with half an hour readings and, after steady temperature is reached, at an interval of 2 hours. In case it is essential, the drying process can be supplemented by blower.

### SPECIFIC ELECTRICAL REQUIREMENT FOR EOT CRANES/ ELECTRIC HOIST

| SL.NO. | PARAMETERS                                              | UNIT     | ENNORE                                                                                                                                                                                                                                                                                                                                                               |  |
|--------|---------------------------------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|        | <b>MOTOR</b>                                            |          |                                                                                                                                                                                                                                                                                                                                                                      |  |
| 1      | DESIGN AMBIENT TEMP                                     | DEG. C   | 50                                                                                                                                                                                                                                                                                                                                                                   |  |
| 2      | VOLTAGE SUPPLY AND VARIATION                            | VOLT     | 415V, $\pm 10\%$                                                                                                                                                                                                                                                                                                                                                     |  |
| 3      | FREQUENCY WITH VARIATION                                | Hz       | 50 (+) 3% to (-) 5%                                                                                                                                                                                                                                                                                                                                                  |  |
| 4      | COMBINED VOLTAGE & FREQUENCY VARIATION                  |          | 10%                                                                                                                                                                                                                                                                                                                                                                  |  |
| 5      | MAX ACCEPTABLE RATING OF MOTOR AT 415 V                 | KW       | 160 kW                                                                                                                                                                                                                                                                                                                                                               |  |
| 6      | SYSTEM FAULT LEVEL AND ITS DUARTION                     | KA       | 50 KA, 1 Sec                                                                                                                                                                                                                                                                                                                                                         |  |
| 7      | SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION |          | 50 KA, 0.25 sec                                                                                                                                                                                                                                                                                                                                                      |  |
| 8      | CLASS OF INSULATION & TEMP RISE LIMITED TO              |          | Class-F and temp rise limited to Class-B                                                                                                                                                                                                                                                                                                                             |  |
| 9      | MIN. STARTING VOLTAGE                                   |          | 85%                                                                                                                                                                                                                                                                                                                                                                  |  |
| 10     | MOTOR RATING FOR SINGLE PHASE SUPPLY                    |          | Upto 200W                                                                                                                                                                                                                                                                                                                                                            |  |
| 11     | MAXIMUM LOCKED ROTOR CURRENT                            | % OF FLC | For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.                                                                                                   |  |
| 12     | ACCEPTABLE NOISE LEVEL                                  | DB       | 85dB at 1.0m in line with IS 12065                                                                                                                                                                                                                                                                                                                                   |  |
| 13     | TYPE OF STARTER PROVIDED IN MCC                         |          | N.A.                                                                                                                                                                                                                                                                                                                                                                 |  |
| 14     | DOP OF ENCLOSURE                                        |          | Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.                                              |  |
| 15     | SPACE HEATER REQUIREMENT                                |          | 30KW & ABOVE                                                                                                                                                                                                                                                                                                                                                         |  |
| 16     | PAINT SHADE                                             |          | Shall be confirmed during detailed engineering.                                                                                                                                                                                                                                                                                                                      |  |
| 17     | SPECIAL REQUIREMENT                                     |          | <p>Type test to be conducted on the identical motor in the last 5 years or after the last design change, which ever is earlier. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design.</p> <p>All motors shall be subjected to routine tests as per IS: 325.</p> <p>The motors shall generally conform to IS 325/IEC-60034.</p> |  |

|  |                                                               |                                   |
|--|---------------------------------------------------------------|-----------------------------------|
|  | <b>TITLE</b><br><br><b>MOTOR</b><br><br><b>DATA SHEET - C</b> | <b>SPECIFICATION NO.</b>          |
|  |                                                               | <b>VOLUME II B</b>                |
|  |                                                               | <b>SECTION D</b>                  |
|  |                                                               | <b>REV NO. 00 DATE 29/08/2005</b> |
|  |                                                               | <b>SHEET 1 OF 2</b>               |

| <b>S. No.</b> | <b>Description</b>                                                 |                              | <b>Data to be filled by successful bidder</b> |
|---------------|--------------------------------------------------------------------|------------------------------|-----------------------------------------------|
| <b>A.</b>     | <b>General</b>                                                     |                              |                                               |
| 1             | Manufacturer & country of origin                                   |                              |                                               |
| 2             | Motor type                                                         |                              |                                               |
| 3             | Type of starting                                                   |                              |                                               |
| 4             | Name of the equipment driven by motor & Quantity                   |                              |                                               |
| 5             | Maximum Power requirement of driven equipment                      |                              |                                               |
| 6             | Rated speed of Driven Equipment                                    |                              |                                               |
| 7             | Design ambient temperature                                         |                              |                                               |
| <b>B.</b>     | <b>Design and Performance Data</b>                                 |                              |                                               |
| 1             | Frame size & type designation                                      |                              |                                               |
| 2             | Type of duty                                                       |                              |                                               |
| 3             | Rated Voltage                                                      |                              |                                               |
| 4             | Permissible variation for                                          |                              |                                               |
| 5             | a                                                                  | Voltage                      |                                               |
| 6             | b                                                                  | Frequency                    |                                               |
| 7             | c)                                                                 | Combined voltage & frequency |                                               |
| 8             | Rated output at design ambient temp (by resistance method)         |                              |                                               |
| 9             | Synchronous speed & Rated slip                                     |                              |                                               |
| 10            | Minimum permissible starting voltage                               |                              |                                               |
| 11            | Starting time in sec with mechanism coupled                        |                              |                                               |
| 12            | a) At rated voltage                                                |                              |                                               |
| 13            | b) At min starting voltage                                         |                              |                                               |
| 14            | Locked rotor current as percentage of FLC (including IS tolerance) |                              |                                               |
| 15            | Torque                                                             |                              |                                               |
|               | a) Starting                                                        |                              |                                               |
|               | b) Maximum                                                         |                              |                                               |
| 16            | Permissible temp rise at rated output over ambient temp & method   |                              |                                               |
| 17            | Noise level at 1.0 m (dB                                           |                              |                                               |
| 18            | Amplitude of vibration                                             |                              |                                               |
| 19            | Efficiency & P.F. at rated voltage & frequency                     |                              |                                               |
|               | a) At 100% load                                                    |                              |                                               |
|               | c) At 75% load                                                     |                              |                                               |

|                       |                  |             |             |             |  |
|-----------------------|------------------|-------------|-------------|-------------|--|
| <b>NAME OF VENDOR</b> |                  |             | <b>SEAL</b> | <b>REV.</b> |  |
|                       |                  |             |             |             |  |
| <b>NAME</b>           | <b>SIGNATURE</b> | <b>DATE</b> |             |             |  |

*Anshul*  
Anshul

*S A Khan*  
S A Khan

*Praveen Kishore*  
Praveen Kishore

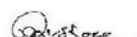
|                                                                                   |                                                               |                                   |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------|
|  | <b>TITLE</b><br><br><b>MOTOR</b><br><br><b>DATA SHEET - C</b> | <b>SPECIFICATION NO.</b>          |
|                                                                                   |                                                               | <b>VOLUME II B</b>                |
|                                                                                   |                                                               | <b>SECTION D</b>                  |
|                                                                                   |                                                               | <b>REV NO. 00 DATE 29/08/2005</b> |
|                                                                                   |                                                               | <b>SHEET 2 OF 2</b>               |

| S. No.    | Description                                                                                         | Data to be filled by successful bidder |
|-----------|-----------------------------------------------------------------------------------------------------|----------------------------------------|
|           | c) At starting                                                                                      |                                        |
| <b>C.</b> | <b>Constructional Features</b>                                                                      |                                        |
| 1         | Method of connection of motor driven equipment                                                      |                                        |
| 2         | Applicable Standard                                                                                 |                                        |
| 3         | DOP of Enclosure                                                                                    |                                        |
| 4         | Method of cooling                                                                                   |                                        |
| 5         | Class of insulation                                                                                 |                                        |
| 6         | Main terminal box                                                                                   |                                        |
|           | a) Type                                                                                             |                                        |
|           | b) Power Cable details (Conductor, size, armour/unarmour)                                           |                                        |
|           | c) Cable Gland & lugs details (Size, type & material)                                               |                                        |
|           | d) Permissible Fault level ( kArms & duration in sec)                                               |                                        |
| 7         | Space heater details (Voltage & watts)                                                              |                                        |
| 8         | Flame proof motor details (if applicable)                                                           |                                        |
|           | a) Enclosure                                                                                        |                                        |
|           | b) suitability for hazardous area                                                                   |                                        |
|           | i Zone                                                                                              | O / I / II                             |
|           | ii Group                                                                                            | IIA / IIB / IIC                        |
| 9         | No. of Stator winding                                                                               |                                        |
| 10        | Winding connection                                                                                  |                                        |
| 11        | Kind of rotor winding                                                                               |                                        |
| 12        | Kind of bearings                                                                                    |                                        |
| 13        | Direction of rotation when viewed from NDE                                                          |                                        |
| 14        | Paint Shade & type                                                                                  |                                        |
| 15        | Net weight of motor                                                                                 |                                        |
| 16        | Outline mounting drawing No (To be enclosed as annexure)                                            |                                        |
| <b>D.</b> | <b>Characteristic curves/ drawings</b><br>(To be enclosed for motors of rating $\geq 55\text{KW}$ ) |                                        |
|           | a) Torque speed characteristic                                                                      |                                        |
|           | b) Thermal withstand characteristic                                                                 |                                        |
|           | c) Current vs time                                                                                  |                                        |
|           | d) Speed vs time                                                                                    |                                        |

|                |           |      |      |      |  |
|----------------|-----------|------|------|------|--|
| NAME OF VENDOR |           |      | SEAL | REV. |  |
|                |           |      |      |      |  |
| NAME           | SIGNATURE | DATE |      |      |  |

  
Anshul

  
S.A. Khan

  
Pawan Kishore



|                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                     |                       |               |                      |                                       |                     |                     |                  |                |                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|-----------------------|---------------|----------------------|---------------------------------------|---------------------|---------------------|------------------|----------------|--------------------|
|                                                                                                                                                                                                                                                                                                                        |                     | <b>QUALITY PLAN</b> |                       | CUSTOMER :    |                      | PROJECT                               |                     | SPECIFICATION :     |                  |                |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                     |                       | BIDDER/ :     |                      | TITLE                                 |                     | NUMBER :            |                  |                |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                     |                       | VENDOR        |                      | QUALITY PLAN                          |                     | SPECIFICATION :     |                  |                |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                     |                       | SYSTEM        |                      | ITEM AC ELECT. MOTORS BELOW 55KW (LV) |                     | TITLE :             |                  |                |                    |
| SL. NO.                                                                                                                                                                                                                                                                                                                                                                                                   | COMPONENT/OPERATION | SHEET 2 OF 2        | CHARACTERISTICS CHECK | CAT.          | TYPE/METHOD OF CHECK | EXTENT OF CHECK                       | REFERENCE DOCUMENT  | ACCEPTANCE NORM     | FORMAT OF RECORD | SECTION AGENCY | VOLUME III REMARKS |
| 1                                                                                                                                                                                                                                                                                                                                                                                                         | 2                   | 3                   | 4                     | 5             | 6                    | 7                                     | 8                   | 9                   | 10               | 11             |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                     | 3.NAMEPLATE DETAILS   | MA            | VISUAL               | 100%                                  | IS-325 & DATA SHEET | IS-325 & DATA SHEET | INSPN. REPORT    | 2 1 -          |                    |
| <b>NOTES:</b>                                                                                                                                                                                                                                                                                                                                                                                             |                     |                     |                       |               |                      |                                       |                     |                     |                  |                |                    |
| 1. ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION. (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.<br>2. FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. |                     |                     |                       |               |                      |                                       |                     |                     |                  |                |                    |
| <u>Legends for Inspection agency</u><br>1. BHEL/CUSTOMER<br>2. VENDOR (MOTOR MANUFACTURER)<br>3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)<br>P. PERFORM<br>W. WITNESS<br>V. VERIFY                                                                                                                                                                                                                   |                     |                     |                       |               |                      |                                       |                     |                     |                  |                |                    |
| BHEL                                                                                                                                                                                                                                                                                                                                                                                                      |                     | PARTICULARS         |                       | BIDDER/VENDOR |                      |                                       |                     |                     |                  |                |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                           |                     | NAME                |                       |               |                      |                                       |                     |                     |                  |                |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                           |                     | SIGNATURE           |                       |               |                      |                                       |                     |                     |                  |                |                    |
|                                                                                                                                                                                                                                                                                                                                                                                                           |                     | DATE                |                       |               |                      |                                       |                     |                     |                  |                |                    |
| BIDDER'S/VENDORS COMPANY SEAL                                                                                                                                                                                                                                                                                                                                                                             |                     |                     |                       |               |                      |                                       |                     |                     |                  |                |                    |

Anshul

S. H. Khan

Praveen /Katore





**2x660MW ENNORE STPP  
AIR CONDITIONING SYSTEM**

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

**SPECIFICATION NO. PE-TS-412-553-A001**

**SECTION : I**

**SUB SECTION : C 6**

**REV 01**

**DATE: Feb 2017**

**SECTION-I**

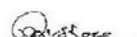
**SUB SECTION C6**

**ANNEXURE-I**

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

  
Anshul

  
S A Khan

  
Pawan Kishore



**2x660MW ENNORE STPP  
AIR CONDITIONING SYSTEM**

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**REV 01**

**DATE: Feb 2017**

**LIST OF MAKES**

| S. NO. | ITEM                      | SUB-SUPPLIER                           |
|--------|---------------------------|----------------------------------------|
| 1      | SCREW CHILLER             | YORK                                   |
|        |                           | TRANE                                  |
|        |                           | CARRIER                                |
|        |                           | KIRLOSKAR                              |
|        |                           | DUNHAM BUSH                            |
|        |                           | MCQUAY (DAIKIN)                        |
|        |                           | BLUE STAR                              |
|        |                           | VOLTAS                                 |
| 2      | VAPOUR ABSORBTION MACHINE | VOLTAS                                 |
|        |                           | THERMAX                                |
| 3      | PRECISION PACKAGE UNITS   | STULZ                                  |
|        |                           | UNIFLAIR                               |
|        |                           | EMERSON PROCESS MANAGEMENT (ROSEMOUNT) |
|        |                           | BLUEBOX                                |
|        |                           | CLIMADENTA                             |
| 4      | PACKAGE UNIT              | VOLTAS                                 |
|        |                           | BLUE STAR                              |
|        |                           | CARRIER                                |
| 5      | SPLIT AIR CONDITIONER     | VOLTAS                                 |
|        |                           | BLUE STAR                              |
|        |                           | CARRIER                                |
|        |                           | HITACHI-HIREL                          |
|        |                           | LG                                     |
| 6      | AIR HANDLING UNITS        | VOLTAS                                 |
|        |                           | BLUE STAR                              |
|        |                           | ZECO                                   |
|        |                           | CARRYAIR                               |
|        |                           | EDGE TECH                              |
|        |                           | ETHOS                                  |
|        |                           | SYSTEM AIR                             |



**2x660MW ENNORE STPP  
AIR CONDITIONING SYSTEM**

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

**SPECIFICATION NO. PE-TS-412-553-A001**

**SECTION : I**

**SUB SECTION : C 6**

**REV 01**

**DATE: Feb 2017**

| S. NO. | ITEM                        | SUB-SUPPLIER                    |
|--------|-----------------------------|---------------------------------|
| 7      | AHU FAN (CENTRIFUGAL FAN)   | WAVES AIRCON                    |
|        |                             | CB DOCTOR                       |
|        |                             | FLAKT                           |
|        |                             | KRUGER                          |
|        |                             | NICOTRA                         |
|        |                             | COMEFRI                         |
|        |                             | MARATHON                        |
| 8      | MISC. PUMPS (HORIZONTAL)    | PATEL AIR                       |
|        |                             | BEST & CROMPTON                 |
|        |                             | JYOTI                           |
|        |                             | SAM TURBO                       |
|        |                             | KBL                             |
|        |                             | KSB                             |
|        |                             | M&P                             |
|        |                             | VOLTAS                          |
|        |                             | BEACON-WEIR                     |
|        |                             | WORTHINGTON                     |
|        |                             | FLOWMORE                        |
|        |                             | SULZER PUMPS INDIA LTD.         |
|        |                             | BHARAT PUMPS & COMPRESSORS LTD  |
|        |                             | FLOWSERVE INDIA CONTROL PVT LTD |
| 9      | COOLING TOWER FOR AC SYSTEM | V-FLOW PUMPS & SYSTEMS CO       |
|        |                             | PAHARPUR                        |
|        |                             | MIHIR                           |
|        |                             | PCT                             |
|        |                             | FLOWTECH                        |
| 10     | LV MOTORS (NON FLAME PROOF) | BELL                            |
|        |                             | SIEMENS                         |
|        |                             | ABB                             |
|        |                             | CGL                             |
|        |                             | MARATHON                        |
|        |                             | KEC                             |
|        |                             | BHARAT BIJLEE                   |
|        |                             | NGEF                            |
|        |                             | JYOTI                           |



**2x660MW ENNORE STPP  
AIR CONDITIONING SYSTEM**

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

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| S. NO. | ITEM             | SUB-SUPPLIER  |
|--------|------------------|---------------|
|        |                  | LHP           |
|        |                  | PUROLATOR     |
|        |                  | FMI           |
|        |                  | ANFILCO       |
|        |                  | TENACITY      |
|        |                  | JOHN FOWLER   |
|        |                  | SPECTRUM      |
|        |                  | AIR TECH      |
|        |                  | PUROMATIC     |
|        |                  | FLAKT         |
|        |                  | KHAITAN       |
|        |                  | PATEL AIR     |
|        |                  | NICOTRA       |
|        |                  | SARLA         |
|        |                  | KRUGER        |
|        |                  | MARATHON      |
|        |                  | C DOCTOR      |
|        |                  | BEARDSHEL     |
|        |                  | K-FLEX        |
|        |                  | PARAMONT      |
|        |                  | ARMAFLEX      |
|        |                  | SUPREME       |
|        |                  | LLOYDS        |
|        |                  | UP TWIGA      |
|        |                  | AEROCELL      |
| 14     | BALANCING VALVE  | ADVANCE       |
|        |                  | AUDCO         |
|        |                  | FOURESS ENGG  |
|        |                  | INTER VALVE   |
|        |                  | BDK           |
|        |                  | WEIR BDK      |
|        |                  | TYCO          |
|        |                  | CRANE PROCESS |
|        |                  | KEystone      |
| 16     | NON RETURN VALVE | LEADER VALVES |



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|--------|------------------------------------------|-----------------------------|
|        |                                          | H SARKAR                    |
|        |                                          | FLUIDLINE                   |
|        |                                          | HI-TECH                     |
|        |                                          | CRESCENT VALVES             |
|        |                                          | A V VALVES                  |
|        |                                          | BANKIM                      |
|        |                                          | SHIVADURGA                  |
| 17     | STEEL GATE/GLOBE/NR VALVES(WATER SYSTEM) | CRESCENT VALVES             |
|        |                                          | BDK                         |
|        |                                          | AUDCO                       |
|        |                                          | FOURESS ENGG                |
|        |                                          | KIRLOSKAR BROTHERS LTD.     |
|        |                                          | SANT VALVES                 |
|        |                                          | BOMBAY METAL & ALLOYS       |
|        |                                          | BANKIM                      |
|        |                                          | LEADER VALVES               |
|        |                                          | H SARKAR                    |
|        |                                          | AV VALVES                   |
|        |                                          | VENUS PUMPS                 |
| 18     | 3 WAY MIXING VALVE WITH ACTUATING MOTOR  | SIEMENS BUILDING TECHNOLOGY |
|        |                                          | JOHNSON                     |
|        |                                          | BELIMO                      |
|        |                                          | HONEYWELL AUTOMATION        |
|        |                                          | RAPID CONTROL               |
| 19     | BUTTERFLY VALVE (MOTORIZED)              | ALC                         |
|        |                                          | ANERGY                      |
|        |                                          | ADVANCE                     |
|        |                                          | BELIMO                      |
|        |                                          | JOHNSON                     |
|        |                                          | HONEYWELL AUTOMATION        |
| 20     | Y / POT STRAINER                         | SIEMENS                     |
|        |                                          | MULTITEX                    |
|        |                                          | GREAVES COTTON              |
|        |                                          | JAYPEE                      |
|        |                                          | SANT VALVES                 |



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|--------|--------------------------------------|------------------------------------|
|        |                                      | OTOKLIN                            |
|        |                                      | GRAND PRIX                         |
|        |                                      | GUJARAT OTOLIFT                    |
|        |                                      | DS ENGG                            |
|        |                                      | SAROJINI ENTERPRISE                |
|        |                                      | BHATIA ENGINEERING                 |
|        |                                      | FILTRATION ENGINEERS INDIA PVT LTD |
|        |                                      | SUNGOV ENGINEERING                 |
| 21     | PIPES (MS/GI) - ERW                  | SURYA ROSHNI                       |
|        |                                      | TISCO                              |
|        |                                      | DADU PIPES                         |
|        |                                      | INDUS TUBES                        |
|        |                                      | WELSPUN                            |
|        |                                      | TATA                               |
|        |                                      | BST                                |
|        |                                      | JINDAL                             |
| 22     | PIPING - CS SEAMLESS (ASTM A 106)    | SAIL                               |
|        |                                      | ISMT                               |
| 23     | GI SHEETS FOR DUCTING                | MAHARASTRA SEAMLESS                |
|        |                                      | TISCO                              |
|        |                                      | INDIAN IRON & STEEL CO             |
|        |                                      | RASHTRIYA ISPAT NIGAM LIMITED      |
|        |                                      | ESSAR                              |
|        |                                      | ISPAT INDUSTRIES                   |
|        |                                      | JSW                                |
|        |                                      | LLOYDS                             |
|        |                                      | BHUSHAN STEELS                     |
|        |                                      | TATA                               |
|        |                                      | SAIL                               |
| 24     | FIRE DAMPER                          | JINDAL                             |
|        |                                      | TSC                                |
|        |                                      | CARRYAIRE                          |
| 25     | GRILL/DIFFUSER/VOLUME CONTROL DAMPER | RAVISTAR (SYSTEM AIR )             |
|        |                                      | AIR FLOW                           |
|        |                                      | TSC                                |



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|--------|----------------------------------------|-------------------------------|
|        |                                        | AIR MASTER                    |
|        |                                        | CARRYAIR                      |
|        |                                        | RAVISTAR (SYSTEM AIR )        |
| 26     | STRIP HEATER                           | ESCORTS                       |
|        |                                        | RACOLDS                       |
|        |                                        | DASPASS                       |
|        |                                        | ALCO                          |
|        |                                        | HEATCO                        |
|        |                                        | HOTSET                        |
| 27     | PAN HUMIDIFIER                         | RAPID COOL                    |
|        |                                        | HOTSET                        |
|        |                                        | ALCO                          |
| 28     | RELIEF / PURGE VALVE                   | BRASSOMATIC                   |
| 29     | THERMOSTATS                            | HONEYWELL AUTOMATION          |
|        |                                        | RANCO                         |
|        |                                        | PENN                          |
|        |                                        | DANFOSS                       |
|        |                                        | INDFOSS                       |
|        |                                        | JHONSON CONTROL               |
|        |                                        | RANUTROL                      |
| 30     | HUMID STAT                             | JHONSON CONTROL               |
|        |                                        | HONEYWELL AUTOMATION          |
|        |                                        | PENN                          |
| 31     | ANTI FREEZE THERMOSTAT                 | RANCO                         |
|        |                                        | HONEYWELL AUTOMATION          |
|        |                                        | PENN                          |
|        |                                        | DANFOSS                       |
|        |                                        | INDFOSS                       |
| 32     | PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | GENERAL INSTRUMENT CONSORTIUM |
|        |                                        | BELLS CONTROLS LTD            |
|        |                                        | H. GURU IND                   |
|        |                                        | WAAREE INSTRUMENTS            |
|        |                                        | H. GURU INST                  |
|        |                                        | FORBES MARSHALL               |
|        |                                        | MANOMETER INDIA               |



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|--------|-------------------|-------------------------------------|
|        |                   | A. N INSTRUMENT                     |
|        |                   | GAUGES BOURDON                      |
|        |                   | GLUCK INDIA                         |
|        |                   | WIKA.                               |
|        |                   | ASHCROFT INDIA PVT LTD.             |
|        |                   | BAUMER TECHNOLOGIES INDIA PVT. LTD. |
|        |                   | PRECISION MASS PRODUCTS             |
|        |                   | BOSE PANDA INSTRUMENTS PVT.LTD.     |
| 33     | TEMPERATURE GAUGE | H. GURU IND                         |
|        |                   | H. GURU INST                        |
|        |                   | FORBES MARSHALL                     |
|        |                   | DETRIVE INST & ELECTRONICS          |
|        |                   | PYRO ELECTRIC                       |
|        |                   | TOSHNIWAL                           |
|        |                   | BROSS                               |
|        |                   | WAREE INSTRUMENTS                   |
|        |                   | A. N INSTRUMENT                     |
|        |                   | GOA INSTRUMENTS                     |
|        |                   | WIKA                                |
|        |                   | ASHCROFT INDIA PVT LTD.             |
|        |                   | H. GURU IND                         |
|        |                   | BAUMER TECHNOLOGIES INDIA PVT. LTD. |
|        |                   | GOA THERMOSTATIC                    |
|        |                   | GAUGES BOURDON                      |
| 34     | LEVEL INDICATOR   | BUDENBERG GAUGE                     |
|        |                   | PRECISION MASS PRODUCTS             |
|        |                   | GENERAL INSTRUMENT CONSORTIUM       |
|        |                   | CHEMTROL                            |
|        |                   | SBEM                                |
|        |                   | AUTOMAT MUMBAI                      |
|        |                   | SIGMA                               |
|        |                   | TOSHNIWAL                           |
|        |                   | TECHNOMATIC                         |
|        |                   | TELACO                              |
|        |                   | LEVCON                              |



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|--------|---------------------------------------------|-------------------------|
|        |                                             | D K INSTRUMENTS         |
|        |                                             | PUNE TECHTROL           |
|        |                                             | FLOW STAR               |
|        |                                             | BLISS ANAND             |
| 35     | PRESSURE/ DP/ VACUUM/<br>TEMPERATURE SWITCH | BELLS CONTROLS LTD      |
|        |                                             | DANFOSS                 |
|        |                                             | DK INSTRUMENTS          |
|        |                                             | DRESSER                 |
|        |                                             | SOR INC                 |
|        |                                             | VASU                    |
|        |                                             | SWITZER INSTRUMENT LTD. |
|        |                                             | INDFOSS                 |
|        |                                             | TRAFAG                  |
|        |                                             | GIC                     |
|        |                                             | ASHCROFT INDIA PVT LTD. |
|        |                                             | KASTURBA UDYOG          |
|        |                                             | BARKSDALE GMBH          |
|        |                                             | PRECISION MASS PRODUCTS |
|        |                                             | MITTAL REFRIGERATION    |
| 36     | TEMPERATURE SWITCH                          | INDFOSS                 |
|        |                                             | SIEMENS                 |
|        |                                             | DANFOSS                 |
|        |                                             | DK INSTRUMENTS          |
|        |                                             | SOR INC                 |
|        |                                             | VASU                    |
|        |                                             | DRESSER                 |
|        |                                             | TOSHNIWAL               |
|        |                                             | SWITZER INSTRUMENT LTD. |
| 37     | FLOW SWITCH                                 | SWITZER INSTRUMENT LTD. |
| 38     | FLOW SWITCH                                 | LEVCON                  |
|        |                                             | DK INSTRUMENTS          |
|        |                                             | SBEM                    |
|        |                                             | V AUTOMAT               |
|        |                                             | SIEMENS                 |
| 39     | LEVEL SWITCH-FLOAT TYPE                     | SBEM                    |



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|--------|----------------------------------|-------------------------------------|
|        |                                  | BLISS ANAND                         |
|        |                                  | HI-TECH                             |
|        |                                  | RAMAN INST                          |
|        |                                  | SIGMA                               |
|        |                                  | SOR INC                             |
|        |                                  | WAREE INST                          |
|        |                                  | LEVCON                              |
|        |                                  | DK INSTRUMENTS                      |
|        |                                  | V AUTOMAT                           |
|        |                                  | CHEMTROL                            |
|        |                                  | SIEMENS                             |
|        |                                  | FLOW STAR                           |
|        |                                  | TRAC                                |
|        |                                  | FLOW TECH                           |
|        |                                  | NIVO CONTROLS                       |
|        |                                  | PUNE TECHTROL                       |
|        |                                  | SAPCON INSTRUMENT                   |
|        |                                  | BAUMER TECHNOLOGIES INDIA PVT. LTD. |
|        |                                  | GIC                                 |
| 40     | LEVEL SWITCH-CAPACITANCE<br>TYPE | SBEM                                |
|        |                                  | BLISS ANAND                         |
|        |                                  | HI-TECH                             |
|        |                                  | RAMAN INST                          |
|        |                                  | SIGMA                               |
|        |                                  | SOR INC                             |
|        |                                  | WAREE INST                          |
|        |                                  | LEVCON                              |
|        |                                  | DK INSTRUMENTS                      |
|        |                                  | V AUTOMAT                           |
|        |                                  | CHEMTROL                            |
|        |                                  | SIEMENS                             |
|        |                                  | FLOW STAR                           |
|        |                                  | TRAC                                |
|        |                                  | FLOW TECH                           |
|        |                                  | NIVO CONTROLS                       |



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|--------|--------------------------------------|----------------------------------------|
| 41     | FLOW TRANSMITTERS                    | PUNE TECHTROL                          |
|        |                                      | SAPCON INSTRUMENT                      |
|        |                                      | BAUMER TECHNOLOGIES INDIA PVT. LTD.    |
|        |                                      | GIC                                    |
|        |                                      | SBEM                                   |
|        |                                      | TAYLOR                                 |
|        |                                      | ABB                                    |
|        |                                      | BRISTOL BABCOCK                        |
|        |                                      | BIRLA KENT TAYLOR                      |
|        |                                      | BLISS ANAND                            |
|        |                                      | SMART INST                             |
|        |                                      | V AUTOMAT                              |
|        |                                      | FISHER-ROSEMOUNT                       |
|        |                                      | SIEMENS                                |
|        |                                      | TATA HONEYWELL                         |
|        |                                      | PUNE TECHTROL                          |
|        |                                      | NIVO CONTROLS                          |
|        |                                      | PANAM ENGINEERS                        |
|        |                                      | EMERSON PROCESS MANAGEMENT (ROSEMOUNT) |
|        |                                      | MOORE                                  |
| 42     | PRESSURE/ DIFF. PRESSURE TRANSMITTER | TOSHNIWAL                              |
|        |                                      | YOKOGAWA                               |
|        |                                      | E&H                                    |
|        |                                      | ABB                                    |
|        |                                      | SBEM                                   |
|        |                                      | TAYLOR                                 |
|        |                                      | ABB                                    |
|        |                                      | BRISTOL BABCOCK                        |
|        |                                      | BIRLA KENT TAYLOR                      |
|        |                                      | BLISS ANAND                            |
|        |                                      | SMART INST                             |
|        |                                      | V AUTOMAT                              |
|        |                                      | FISHER-ROSEMOUNT                       |
|        |                                      | SIEMENS                                |
|        |                                      | TATA HONEYWELL                         |



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|--------|------------------------|-------------------------------------------|
|        |                        | PUNE TECHTROL                             |
|        |                        | NIVO CONTROLS                             |
|        |                        | PANAM ENGINEERS                           |
|        |                        | EMERSON PROCESS MANAGEMENT<br>(ROSEMOUNT) |
|        |                        | MOORE                                     |
|        |                        | TOSHNIWAL                                 |
|        |                        | YOKOGAWA                                  |
|        |                        | E&H                                       |
|        |                        | ABB                                       |
| 43     | SIGHT FLOW INDICATORS  | SIGMA                                     |
|        |                        | LEVCON                                    |
|        |                        | V AUTOMAT                                 |
|        |                        | TELLACE                                   |
|        |                        | EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.     |
|        |                        | TATA HONEYWELL                            |
|        |                        | BLISS ANAND                               |
|        |                        | SCIENTIFIC DEVICES                        |
|        |                        | BK EQUIPMENTS                             |
|        |                        | INSTRUMENTATION ENGINEERS                 |
| 44     | FLOW ELEMENT - ORIFICE | BRISTOL BABCOCK                           |
|        |                        | BALIGA LIGHTING EQPT PVT LTD              |
|        |                        | LIGHTING EQUIP                            |
|        |                        | ENGINEERING SPECIALITIES                  |
|        |                        | IL                                        |
|        |                        | MINCO                                     |
|        |                        | MICRO PRECISION                           |
|        |                        | STAR-MECH CONTROLS (I) PVT.LTD.           |
| 45     | TEMPERATURE ELEMENT    | GENERAL INSTRUMENT CONSORTIUM             |
|        |                        | PYRO ELECTRIC                             |
|        |                        | WAAREE INSTRUMENTS                        |
|        |                        | DETRIVE INST & ELECTRONICS                |
|        |                        | TOSHNIWAL                                 |
|        |                        | GOA INSTRUMENTS                           |
|        |                        | GAUGES BOURDON                            |
|        |                        | TECHNO INSTRUMENTS                        |



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|--------|-----------------------|---------------------------------------|
|        |                       | TEMPSSENS INSTRUMENTS                 |
|        |                       | THERMAL INSTRUMENTS                   |
|        |                       | TM TECNOMATIC SPA                     |
|        |                       | BAUMER TECHNOLOGIES INDIA PVT. LTD.   |
| 46     | FLOW METER            | EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD. |
|        |                       | INSTRUMENTATION ENGINEERS             |
|        |                       | PLACKA                                |
|        |                       | TRAC                                  |
|        |                       | FLOW STAR                             |
|        |                       | SCIENTIFIC DEVICES                    |
| 47     | RH SENSOR/TEMP SENSOR | HONEYWELL AUTOMATION                  |
|        |                       | JOHNSON                               |
|        |                       | SIEMENS                               |
|        |                       | GENERAL INSTRUMENT CONSORTIUM         |
| 48     | PLC BASED PANEL       | SIEMENS                               |
|        |                       | SCHNEIDER                             |
|        |                       | ROCKWELL AUTOMATION                   |
|        |                       | GE INTELLIGENT                        |
|        |                       | HONEYWELL AUTOMATION                  |
|        |                       | ABB                                   |
| 49     | OWS/PC                | MITSUBISHI ELECTRIC                   |
|        |                       | HP                                    |
|        |                       | COMPAQ                                |
|        |                       | DELL                                  |
|        |                       | HCL                                   |
|        |                       | IBM                                   |
| 50     | PRINTER               | LENOVO                                |
|        |                       | HP                                    |
|        |                       | CANNON                                |
|        |                       | EPSON                                 |
|        |                       | XEROX                                 |
|        |                       | IBM                                   |
| 51     | UPS                   | LEXMARK                               |
|        |                       | HITACHI-HIREL                         |
|        |                       | APC                                   |



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|--------|---------------------------------------------|----------------------------------------|
|        |                                             | DELTA                                  |
|        |                                             | EMERSON PROCESS MANAGEMENT (ROSEMOUNT) |
|        |                                             | DB POWER                               |
|        |                                             | APLAB                                  |
| 52     | FIBRE OPTIC CABLE                           | BIRLA ERICSSON                         |
|        |                                             | FINOLEX                                |
|        |                                             | AKSH FIBRE                             |
| 53     | ANNUNCIATOR                                 | ICC                                    |
|        |                                             | PECON                                  |
|        |                                             | PROCON                                 |
| 54     | LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR | CONTROL DEVICE                         |
|        |                                             | SYSTEM POWER CONTROL                   |
|        |                                             | JACKSON ENGINEERS                      |
|        |                                             | UNILEC                                 |
|        |                                             | ELECTRIC ALLIED PRODUCT                |
|        |                                             |                                        |
| 55     | METERING PUMPS                              | SHAPO TOOLS                            |
|        |                                             | VK PUMPS                               |
| 56     | WATER SOFTENING PLANT                       | THERMAX                                |
|        |                                             | ION EXCHANGE                           |
|        |                                             | DOSI ION                               |
| 57     | PRESSURE/ DIFF. PRESSURE TRANSMITTER        | ABB                                    |
|        |                                             | ENDRESS+HAUSER (INDIA)                 |
|        |                                             | MOORE                                  |
|        |                                             | SIEMENS                                |
|        |                                             | SMART INST                             |
|        |                                             | SBEM                                   |
|        |                                             | TOSHNIWAL                              |
|        |                                             | V AUTOMAT                              |
|        |                                             | EMERSON PROCESS MANAGEMENT (ROSEMOUNT) |
|        |                                             | YOKOGAWA                               |
|        |                                             | HONEYWELL AUTOMATION                   |
|        |                                             | FUJI                                   |
| 58     | TEMPERATURE TRANSMITTERS                    | ABB                                    |
|        |                                             | ENDRESS+HAUSER (INDIA)                 |



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|--------|----------------------------|-------------------------------------------|
|        |                            | MOORE                                     |
|        |                            | SIEMENS                                   |
|        |                            | SMART INST                                |
|        |                            | SBEM                                      |
|        |                            | TOSHNIWAL                                 |
|        |                            | V AUTOMAT                                 |
|        |                            | EMERSON PROCESS MANAGEMENT<br>(ROSEMOUNT) |
|        |                            | YOKOGAWA                                  |
|        |                            | HONEYWELL AUTOMATION                      |
| 59     | ROTAMETER                  | CHEMTROLS SAMIL ( INDIA) PVT LTD.         |
|        |                            | EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.     |
|        |                            | IL                                        |
|        |                            | TRANSDUCERS AND CONTROL                   |
| 60     | BATTERY CHARGER            | AMARA RAJA POWER SYSTEMS LIMITED          |
|        |                            | CHHABI ELECTRICALS PVT.LTD.               |
|        |                            | DUBAS ENGG                                |
|        |                            | HBL POWER SYSTEM                          |
|        |                            | STATCON POWER CONTROLS LTD                |
|        |                            | CALDYNE                                   |
| 61     | DC LEAD ACID/NI-CD BATTERY | HBL POWER SYSTEM                          |
|        |                            | AMCO SAFT INDIA LTD                       |
|        |                            | SAFT                                      |

NOTE: ABOVE SUB-VENDOR ARE ALSO SUBJECTED TO CUSTOMER APPROVAL DURING DETAILED ENGINEERING.



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MANDATORY SPARE LIST**

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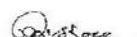
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**SECTION-I  
SUB SECTION –C6**

**ANNEXURE-II  
MANDATORY SPARE LIST**

  
Anshul

  
S A Khan

  
Praveen Kishore



**2x660MW ENNORE STPP  
AIR CONDITIONING SYSTEM  
MANDATORY SPARE LIST**

**SPECIFICATION NO. PE-TS-412-553-A001**

**SECTION : I**

**SUB SECTION : C6**

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**SHEET 2 OF 10**

**A. M                      ECHANICAL**

| S.No.     | Equipment / Package name                            | Qty. for TWO units                 |
|-----------|-----------------------------------------------------|------------------------------------|
|           | <b>AIR CONDITIONING SYSTEM</b>                      |                                    |
| <b>1.</b> | <b>Vapour Compression chiller</b>                   |                                    |
| 1.1       | Oil filter "O" ring                                 | 1 set                              |
| 1.2       | Refrigerant filter                                  | 1 set                              |
| 1.3       | Master solenoid valve                               | 1 No                               |
| 1.4       | Master solenoid valve coil                          | 1 set                              |
| <b>2.</b> | <b>Screw compressors</b>                            |                                    |
| 2.1       | Valve Head assembly                                 | 25 % of each type and rating       |
| 2.2       | Bearings                                            | 25 % of each type and rating       |
| 2.3       | Seal gasket and other wear out parts in sets        | 25 % of each type and rating       |
| 2.4       | O' rings & oil seals                                | 2 set of each rating of compressor |
| 2.5       | Crank case heater                                   | 1 no of each rating of compressor  |
| 2.6       | Suction filter elements                             | 4 set of each rating of compressor |
| 2.7       | Compressor shaft seal assembly                      | 2 set of each rating of compressor |
| 2.8       | Oil pressure failure safety switch                  | 1 set of each rating of compressor |
| <b>3.</b> | <b>Reciprocation compressor</b>                     |                                    |
| 3.1       | Piston ring in sets                                 | 25% of each type and rating        |
| 3.2       | Piston in sets                                      | 30% of each type and rating        |
| 3.3       | Bearing in sets                                     | 25% of each type and rating        |
| 3.4       | Seal gasket and other wear out parts in sets        | 25% of each type and rating        |
| 3.5       | Valve Head assembly                                 | 25% of each type and rating        |
| 3.6       | Crank shaft in sets                                 | 10% of each type and rating        |
| 3.7       | Connecting rod in sets                              | 10% of each type and rating        |
| <b>4.</b> | <b>Pumps (condenser &amp; chilling water pumps)</b> |                                    |
| 4.1       | Pump Impeller                                       | 1 no of each type                  |
| 4.2       | Pump Bearing                                        | 1 set                              |
| 4.3       | Pump Motor Bearing                                  | 1 set                              |
| 4.4       | Shaft Sleeve                                        | 1 set                              |
| <b>5.</b> | <b>Cooling Towers</b>                               |                                    |
| 5.1       | Nozzles for cooling towers                          | 2 set                              |
| 5.2       | Float valve assembly                                | 1 No                               |
| 5.3       | Fan Bearing                                         | 1 set                              |

*Anshul*  
Anshul

*S.A. Khan*  
S.A. Khan

*Praveen Kishore*  
Praveen Kishore



**2x660MW ENNORE STPP  
AIR CONDITIONING SYSTEM  
MANDATORY SPARE LIST**

**SPECIFICATION NO. PE-TS-412-553-A001**

**SECTION : I**

**SUB SECTION : C6**

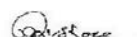
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| S.No.     | Equipment / Package name           | Qty. for TWO units  |
|-----------|------------------------------------|---------------------|
| 5.4       | Motor Bearing                      | 1 set               |
| <b>6.</b> | <b>Packaged Air - conditioners</b> |                     |
| 6.1       | Filters                            | 1 set               |
| 6.2       | Expansion valve                    | 1 set               |
| 6.3       | Motor for compressor               | 1 set               |
| <b>7.</b> | <b>Air Handling Unit</b>           |                     |
| 7.1       | V-Belt for AHU blower              | 2 sets of each type |
| 7.2       | AHU blower bearing                 | 1 sets of each type |
| 7.3       | Filters                            | 2 sets of each type |
| 7.4       | Blower motor bearing               | 1 set               |
| <b>8.</b> | <b>Tube axial fan</b>              |                     |
| 8.1       | Bearing                            | 1 set               |
| 8.2       | Filter                             | 1 set               |
| 8.3       | Motor Bearing                      | 1 set               |

  
Anshul

  
S A Khan

  
Pawan Kishore



**2x660MW ENNORE STPP  
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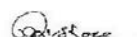
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**415 V Motors (Mandatory Spares)**

| Sl no | Name of spares                                          | Quantity                                                                   |
|-------|---------------------------------------------------------|----------------------------------------------------------------------------|
| 1.    | Terminal plates                                         | 10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW |
| 2.    | Heaters                                                 | 2 sets                                                                     |
| 3.    | Greasing arrangements                                   | 4 sets each type of motor                                                  |
| 4.    | Motor of each type and rating                           | 10% of the installed quantity or minimum 1 number whichever be higher      |
| 5.    | Bearings (DE and NDE) for each type and rating of motor | 4 sets                                                                     |

  
Anshul

  
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**C. C&I**

| Sl no    | Name of spares                                                                                                                                                                                                                                                 | Unit | Qty                                                                                                                                                            |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (I)      | Each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system.                                                                                                                                                                                  | Nos. | 20 % of Installed of each type.                                                                                                                                |
| <b>A</b> | <b>Measuring Instruments</b>                                                                                                                                                                                                                                   |      |                                                                                                                                                                |
| 1        | <b>Indicators, Recorders, Electrical Metering and Skid Mounted Instruments</b>                                                                                                                                                                                 |      |                                                                                                                                                                |
| a.       | Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.                                                                                                                 | Nos. | 10 % of Installed of each type/Model or a minimum of one number for each model and type, whichever is more                                                     |
| b.       | For skid mounted instruments                                                                                                                                                                                                                                   | Nos. | 10% of total number of instruments for each Type and model or a minimum of one number for each model and type, whichever is more                               |
| 2        | <b>Temperature Elements and Thermowells</b>                                                                                                                                                                                                                    |      |                                                                                                                                                                |
| a.       | Thermocouple/RTD elements                                                                                                                                                                                                                                      | Nos. | 10% spare for each type and length of element furnished with thermocouple/RTD assemblies, or a minimum of one number of each type & length, whichever is more. |
| b.       | Thermowells                                                                                                                                                                                                                                                    | Nos. | 10% for each type of temperature sensors or a minimum of one for each type, whichever is more                                                                  |
| 3        | <b>Temperature Transmitters and Electronic Transmitters (For Pressure, DP, Temp, Flow, Level), Temperature, Pressure, Flow &amp; Level Switch, safety switches, Gauges, meters, Transducer or any other instrument etc.</b>                                    | Nos. | 10% of total number of Instruments/transducers offered for each model and type for the project or a minimum of one number, whichever is more.                  |
| <b>B</b> | <b>DDCMIS/PLC system, Master slave clock system, Hart Management System, Vibration Monitoring system, CAAQMS, ERP/MIS/LAN/Simulator/ WAN, CCTV, Microprocessor based control system, and other Control System/Sub-systems/electronic system listed in NIT.</b> |      |                                                                                                                                                                |
| 1        | I/O cards                                                                                                                                                                                                                                                      |      |                                                                                                                                                                |



**2x660MW ENNORE STPP  
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| Sl no | Name of spares                                                                                                                                                                                                                            | Unit | Qty                                                                                                                               |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------|
| a.    | Analog Input module                                                                                                                                                                                                                       | Nos. | 10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)                              |
| b.    | Analog output module                                                                                                                                                                                                                      | Nos. | 10% of qty Installed of each category/ model or at least 2 No. of each type/model (Whichever is more)                             |
| c.    | RTD/TC cards/modules                                                                                                                                                                                                                      | Nos. | 10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)                              |
| d.    | Digital input module                                                                                                                                                                                                                      | Nos. | 10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)                              |
| e.    | Digital output module                                                                                                                                                                                                                     | Nos. | 10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)                              |
| 2     | All types of electronic modules, controllers, function modules, cards, terminal boards, relay boards, power supply cards etc for above mentioned system and other Control System/Sub- systems and any other type of PCB not covered above | Nos. | 10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)                              |
| 3     | Electronic Cards/modules                                                                                                                                                                                                                  | Nos. | 10% of number for each type or minimum of 2 number for each type whichever is high.                                               |
| 4     | Auto/Manual stations, set-point/bias stations etc                                                                                                                                                                                         | Nos. | 10% of the number of stations offered for the project from each type or a minimum of 2 number from each model, whichever is more. |
| 5     | Control logic power supply fuses, MCB, MCCB, at each current rating required for the project.                                                                                                                                             | Nos. | 20% spare for each type/Model                                                                                                     |
| 6     | Electronic cards of each type used for each type of Servers supplied with any control system                                                                                                                                              | Nos. | Ten (10) percent or 2 no. (Whichever is more)                                                                                     |
| 7     | Electric to pneumatic converters of each type utilized with automatic control system using pneumatic drives                                                                                                                               | Nos. | Ten (10) percent of each type or a minimum of one of each type, whichever is more.                                                |
| 8     | Plug-in type keyboard                                                                                                                                                                                                                     | Nos. | 10 nos. of each type/model.                                                                                                       |



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| Sl no | Name of spares                                                                                                                           | Unit | Qty                                                                                             |
|-------|------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------|
| 9     | Control OWS                                                                                                                              | Nos. | Two No. of each type with complete accessories & monitors.                                      |
| 10    | Utility/Engineering OWS                                                                                                                  | Nos. | Two No. of each type with complete accessories & monitors.                                      |
| 11    | DVD/CD                                                                                                                                   | Nos. | 10 boxes                                                                                        |
| 12    | Data highway cable with adequate connectors of each type                                                                                 | Set. | 200 mts. each                                                                                   |
| 13    | Hard disc drive unit                                                                                                                     | Nos. | Five nos of each type                                                                           |
| 14    | Prefab cable connectors                                                                                                                  | Nos. | 10% or 5 nos (whichever is more) of each type of Installed                                      |
| 15    | Cubicle power supply power supply modules                                                                                                | Nos. | Ten (10) percent or 5 nos (whichever is more) of Installed of each type and rating              |
| 16    | Interposing/coupling relays.                                                                                                             | Nos. | Ten (10) percent Installed of each type and rating                                              |
| 17    | Ethernet Switches, Routers & other communication hardware                                                                                | Nos. | 10% of qty Installed of each type or a minimum of 2 numbers from each model, whichever is more. |
| 18    | Sensors with special cables, Power supply modules, Relay, Interface Module, and electronic modules used for vibration monitoring system. | Nos. | 10% of qty installed or Five no. (Whichever is more) of each type)                              |
| 19    | Printer toners for all printers                                                                                                          | Nos. | Ten (10) percent of qty installed or 3 no. (whichever is more)                                  |
| 20    | DMP printer head of the total quantity                                                                                                   | Nos. | 2 nos. of 132 columns of each type                                                              |
| 21    | Drum for A3 sized scanner cum copies, printer                                                                                            | Nos. | 2 nos. of each type                                                                             |
| 22    | 24" LED monitor,                                                                                                                         | Nos. | 3 nos.                                                                                          |
| 23    | 29" LED monitor                                                                                                                          | Nos. | 1 no                                                                                            |
| 24    | 22" LED monitors.                                                                                                                        | Nos. | 5 nos                                                                                           |
| 25    | RJ 45 connector with box of each type                                                                                                    | Nos. | Twenty (20) percent or 2 no. (Whichever is more)                                                |
| 26    | Hooters, Buzzers, Cooling fans of each type.                                                                                             | Nos. | Ten (10) percent or 2 no. (Whichever is more)                                                   |
| 27    | Interface cables                                                                                                                         | Set  | 2 sets of each type/model                                                                       |
| 28    | Power supply modules (AC to DC convertors)                                                                                               | Nos. | 10% or Five no. (Whichever is more) of each type/model                                          |
| 29    | DVD/CD drive unit of each type                                                                                                           | Nos. | 5 nos.                                                                                          |



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| Sl no    | Name of spares                                                                                                                                                                                                         | Unit | Qty                                                                                   |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------|
| 30       | Mouse                                                                                                                                                                                                                  | Nos. | 20 nos. of each type/model.                                                           |
| <b>C</b> | <b>Relay based Control Panels</b>                                                                                                                                                                                      |      |                                                                                       |
| 1        | LEDs for indicating lights                                                                                                                                                                                             | Nos. | 10% of qty installed.                                                                 |
| 2        | Control circuit fuses/MCB/MCCB/<br>Semiconductor Fuses                                                                                                                                                                 | Nos. | 300% of installed of each<br>type, current rating.                                    |
| 3        | Relays modules & contactors.                                                                                                                                                                                           | Nos. | 20% spare of qty Installed of<br>each type & rating.                                  |
| <b>D</b> | <b>Alarm Annunciation System</b>                                                                                                                                                                                       |      |                                                                                       |
| 1        | logic modules, group card modules, power<br>supply modules, Hooters and any other<br>electronic module.                                                                                                                | Nos. | 20% spares of each type<br>installed                                                  |
| 2        | un-engraved window boxes complete with<br>LED etc.                                                                                                                                                                     | Nos. | 5% spares of each size<br>installed                                                   |
| 3        | LEDs for annunciation facia windows and<br>LEDs box assemblies offered for the project.                                                                                                                                | Nos. | 20% of qty installed                                                                  |
| 4        | Annunciator hooter                                                                                                                                                                                                     | Nos. | One (1) No. of each type                                                              |
| <b>E</b> | <b>Un-interrupted Power Supply System and<br/>DC Control Power Supply System</b>                                                                                                                                       |      |                                                                                       |
| 1        | As per Manufacturer's Recommendation for<br>Three Years Continuous Operation or<br>minimum quantities indicated as below<br>(whichever is more)                                                                        |      |                                                                                       |
| 2        | Fuses/Semiconductor Fuses                                                                                                                                                                                              | Nos. | 300% of installed of each<br>type, current rating with each<br>panel /board           |
| 3        | Miscellaneous parts for the power supplies<br>such as SCRS, transistors, resistors, diodes,<br>light bulbs, static switches , blocking diodes<br>etc.                                                                  | Nos. | Minimum of 10% or atleast<br>two (whichever is more) of<br>each type                  |
| 4        | Battery cells complete with contactor, cover<br>plates etc.                                                                                                                                                            | Nos. | 10% of qty installed                                                                  |
| 5        | Electronic Modules like Rectifier control<br>card, inverter control card, Driver card, IGBT<br>Module, DC-DC converter card or any other<br>card as listed in approved BOM for UPS, AC<br>supply & 24 V DC supply etc. | Set  | 1 Set of each type &<br>rating                                                        |
| 6        | Miniature Circuit breakers for AC and DC<br>supply.                                                                                                                                                                    | Nos. | 20 % of installed or 10 Nos<br>of each type (whichever is<br>more) for ACDB and DCDB. |
| 7        | Digital/analog panel meters/indicators                                                                                                                                                                                 | Nos. | 5% or 2 no. of each type<br>(whichever is more)                                       |
| 8        | CT's, CVT's VT's chokes, AC/DC isolators,<br>contactors, timers, relays.                                                                                                                                               | Nos. | 10% or 2 nos. of each type<br>and rating, (whichever is<br>more)                      |



**2x660MW ENNORE STPP  
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| Sl no                      | Name of spares                                                                                         | Unit | Qty                                                                                                                                                                       |
|----------------------------|--------------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9                          | Cooling Fans in UPS & 24 V DC charger panels                                                           | Nos. | 10% or 2 nos. of each type and rating, (whichever is more)                                                                                                                |
| 10                         | Following accessory equipment for the battery shall be furnished :                                     | Set  | Two sets                                                                                                                                                                  |
|                            | a) Cell lifting facilities                                                                             |      |                                                                                                                                                                           |
|                            | b) Assembly wrenches                                                                                   |      |                                                                                                                                                                           |
|                            | c) Vent plug hydrometer thermometer                                                                    |      |                                                                                                                                                                           |
|                            | d) Vent plug                                                                                           |      |                                                                                                                                                                           |
|                            | e) Supply of corrosion-preventive grease.                                                              |      |                                                                                                                                                                           |
|                            | f) 10% spare cells.                                                                                    |      |                                                                                                                                                                           |
| 11                         | Electronic modules of each type & rating for UPS and DC control power supply system.                   | Set  | One set of with each set consisting of at least one number of each type of electronic module for inverters, chargers, static switch, stabilizer etc. as per approved BOM. |
| 12                         | MCCB for UPS & 24 V DC charger panels, ACDB, DCDB.                                                     | Nos. | 20 % of installed or 5 Nos of each type (whichever is more)                                                                                                               |
| <b>F Erection hardware</b> |                                                                                                        |      |                                                                                                                                                                           |
| 1                          | Instrument valves                                                                                      | Nos. | Ten (10) percent of each type & Size installed                                                                                                                            |
| 2                          | Condensate pots of each type & Size installed                                                          | Nos. | Ten (10) percent of total number of Installed or four numbers whichever is higher                                                                                         |
| 3                          | Manifold                                                                                               | Nos. | Ten (10) percent of each type & Size installed                                                                                                                            |
| 4                          | Fittings                                                                                               | Nos. | Ten (10) percent of each type & Size installed                                                                                                                            |
| <b>G</b>                   | <b>Mandatory Spares for Control valves, Power Cylinder, Control Dampers, Actuators and Accessories</b> |      |                                                                                                                                                                           |
| 1                          | Following spares shall be furnished for control valves, Power Cylinder, Control Dampers as applicable. |      |                                                                                                                                                                           |
| 2                          | One set of spare control valve stem packing for each control valve.                                    |      |                                                                                                                                                                           |
| 3                          | Two moulded rubber diaphragms for each control valve.                                                  |      |                                                                                                                                                                           |
| 4                          | One sets of each of O-rings and rubber gaskets for each control valve.                                 |      |                                                                                                                                                                           |



**2x660MW ENNORE STPP  
AIR CONDITIONING SYSTEM  
MANDATORY SPARE LIST**

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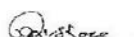
| Sl no    | Name of spares                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Unit | Qty |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----|
| 5        | 100 percent qty. of lubricants for gaskets for each control valve on one year consumption basis.                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |     |
| 6        | 2 sets of limit switches and 1 set of valve positioner for each control valve.                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      |     |
| 7        | 20 percent of position transmitter (4-20mA) for total qty. of control valve.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |     |
| 8        | One (1) set of valve trims (such as plug, stem, seat ring /cage, guide bushing, stem lock pin, packing retaining ring, etc) for each control valve.                                                                                                                                                                                                                                                                                                                                                                                |      |     |
| 9        | One completes actuator of each type or min 10% for each type and size whichever is more.                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |     |
| 10       | 20 percent of Solenoid valves or min 2 no. of each type for total qty. of control valves.                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |     |
| 11       | 20% of I to P converters, Pressure regulators.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      |     |
| <b>H</b> | <b>Mandatory spares not covered above</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |     |
|          | Bidder to supply 10% or 1 no. (whichever is more) of each type of sensor/instrument, instrumentation/mechanical fittings etc for any other electronic system, feeder control cabinets, hydrastep (EWLI), Vibration Monitoring System, CCTV, C&I Lab Instruments, On line Carbon in Ash analyser system, On line Coal mass flow/speed measurement system, On line secondary air flow measurement system Mass Flow meter, Solid flow meter, 3 D Acoustic type level transmitters, Nucleonic & non nucleonic density transmitter etc. |      |     |

**NOTE:**

1. These spares shall be considered as per the applicable items in main supply of AC system package.
2. Spares shall be considered as unit wise except for any item/equipment supplied as common for both unit.

  
Anshul

  
S A Khan

  
Praveen Kishore



**2x660MW ENNORE STPP  
AIR CONDITIONING SYSTEM  
PAINTING & COLOUR SCHEME**

**SPECIFICATION No: PE-TS-412-553-A001**

**SECTION : I**

**SUB-SECTION : C-6**

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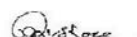
**ANNEXURE-III**

**PAINTING & COLOUR SCHEME**

**(AS PER SECTION C2C)**

  
Anshul

  
S A Khan

  
Praveen Kishore



**2x660MW ENNORE STPP  
AIR CONDITIONING SYSTEM  
LIST OF TOOLS & TACKLES  
AND  
LIST OF COMMISSIONING SPARES**

**SPECIFICATION No: PE-TS-412-553-A001**

**SECTION: I**

**SUB-SECTION : C6**

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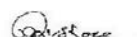
**SUB-SECTION-C6**

**ANNEXURE-IV**

**LIST OF TOOLS & TACKLES  
AND  
LIST OF COMMISSIONING SPARES**

  
Anshul

  
S A Khan

  
Praveen Kishore



**2x660MW ENNORE STPP  
AIR CONDITIONING SYSTEM  
LIST OF TOOLS & TACKLES  
AND  
LIST OF COMMISSIONING SPARES**

**SPECIFICATION No: PE-TS-412-553-A001**

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**LIST OF TOOLS & TACKLES**

| SL NO | ITEM DESCRIPTION                                         | UNIT | QTY |
|-------|----------------------------------------------------------|------|-----|
| 1     | FLAT D WRENCH - 6 MM TO 32 MM (12 Pcs)                   | SET  | 1   |
| 2     | BOX WRENCHES - 6 MM TO 22 MM (14 Pcs)                    | SET  | 1   |
| 3     | RING SPANNER - 6 MM TO 32 MM (12 Pcs)                    | SET  | 1   |
| 4     | ALLEN KEYS - 2 MM TO 10 MM                               | SET  | 1   |
| 5     | CRESCENT SCREW SPANNER                                   | NO.  | 1   |
| 6     | SCREW DRIVER                                             | NO.  | 1   |
| 7     | OFFSET SCREW DRIVER                                      | NO.  | 1   |
| 8     | INSULATED PLIER                                          | NO.  | 1   |
| 9     | TORCH LIGHT FOR 2 CELL                                   | NO.  | 1   |
| 10    | HAMMER 1 LB                                              | NO.  | 1   |
| 11    | OIL CAN                                                  | NO.  | 1   |
| 12    | POCKET THERMOMETER - 0 TO 50 DEG. C)                     | NO.  | 1   |
| 13    | INSULATION TAPE ROLL                                     | NO.  | 1   |
| 14    | STEEL FOOT RULE - 12"                                    | NO.  | 1   |
| 15    | FEELER GAUGE 9 BLADES                                    | NO.  | 1   |
| 16    | PIPE WRENCH                                              | NO.  | 1   |
| 17    | FLARE NUT (1/4")                                         | NOS. | 6   |
| 18    | FLARING TOOL                                             | NO.  | 1   |
| 19    | TUBE CUTTER                                              | NO.  | 1   |
| 20    | GAS CHARGING PIPE                                        | NO.  | 1   |
| 21    | NITROGEN CHARGING ADAPTER                                | NO.  | 1   |
| 22    | FREON PRESSURE GAUGE (2 1/2" DIA DIAL) ) 0 - 300 MM PSI  | NO.  | 1   |
| 23    | FREON PRESSURE GAUGE (2 1/2" DIA DIAL) ) 30 - 150 MM PSI | NO.  | 1   |
| 24    | PSYCHRO METER                                            | NO.  | 1   |
| 25    | LOCK WITH KEY FOR TOOL BOX                               | NO.  | 1   |
| 26    | RATCHET 1/4"                                             | NO.  | 1   |
| 27    | MS TOOL BOX                                              | NO.  | 1   |

**NOTE:-**

Above is the minimum list. Any other Tools and tackles required for the system shall also be provided by the vendor as per system / customer requirement.

**LIST OF COMMISSIONING SPARES**

| SL NO | ITEM DESCRIPTION  | UNIT | QTY   |
|-------|-------------------|------|-------|
| 1     | AHU FAN BELTS     | SET  | 1     |
| 2     | PRESSURE GAUGE    | NO.  | 1     |
| 3     | TEMPERATURE GAUGE | NO.  | 1     |
| 4     | FILTER            | SET  | 1     |
| 5     | COMPRESSOR OIL    | Ltr. | 1 Lot |
| 6     | REFRIGERANT       | Kg   | 1 Lot |

**NOTE:-**

Above is the minimum list. Any other commissioning spare required for the system shall also be provided by the vendor as per system / customer requirement.

*Anshul*  
Anshul

*S.A. Khan*  
S.A. Khan

*Praveen Kishore*  
Praveen Kishore



**2x660MW ENNORE STPP  
AIRCONDITIONING SYSTEM  
DRAWINGS / DOCUMENTS SUBMISSION  
PROCEDURE**

**SPECIFICATION No: PE-TS-412-553-A001**

**SECTION : I**

**SUB-SECTION : C6**

**REV 00**

**DATE: Feb 2017**

**SECTION-I**

**SUB-SECTION-C6**

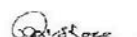
**ANNEXURE-V**

**DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE**

**(COVERED IN C2B)**

  
Anshul

  
S A Khan

  
Praveen Kishore



**2x660MW ENNORE STPP  
AIRCONDITIONING SYSTEM  
MASTER DRAWING LIST WITH SCHEDULE  
OF SUBMISSION**

**SPECIFICATION No: PE-TS-412-553-A001**

**SECTION : I**

**SUB-SECTION : C6**

**REV 00**

**DATE: Feb 2017**

**SHEET 1 OF 4**

**SECTION-I**

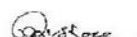
**SUB-SECTION-C5**

**ANNEXURE-VI**

**MASTER DRAWING LIST WITH SCHEDULE OF  
SUBMISSION**

  
Anshul

  
S A Khan

  
Praveen Kishore



**2x660MW ENNORE STPP  
AIRCONDITIONING SYSTEM  
MASTER DRAWING LIST WITH SCHEDULE  
OF SUBMISSION**

**SPECIFICATION No: PE-TS-412-553-A001**  
**SECTION : I**  
**SUB-SECTION : C6**  
**REV 00      DATE: Feb 2017**  
**SHEET 2 OF 4**

| S. NO. | DRAWING NO         | DRG./ DOC. TITLE                                                                                         | SCH. WEEK<br>(FROM<br>DATE OF<br>LOI) |
|--------|--------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------|
| 1      | PE-V0-412-553-A001 | INSPECTION CATEGORISATION PLAN                                                                           | 4                                     |
| 2      | PE-V0-412-553-A002 | QAP OF SCREW CHILLER PACKAGE                                                                             | 14                                    |
| 3      | PE-V0-412-553-A003 | QAP OF AIR HANDLING UNIT                                                                                 | 14                                    |
| 4      | PE-V0-412-553-A004 | QAP OF PUMPS                                                                                             | 15                                    |
| 5      | PE-V0-412-553-A005 | QAP OF COOLING TOWER                                                                                     | 15                                    |
| 6      | PE-V0-412-553-A006 | QAP OF MOTORS                                                                                            | 15                                    |
| 7      | PE-V0-412-553-A007 | QAP OF PLC BASED PANEL                                                                                   | 20                                    |
| 8      | PE-V0-412-553-A101 | HEAT LOAD CALCULATION FOR MAIN PLANT, ESP<br>/ VFD CONTROL ROOMS, SERVICE AND<br>ADMINISTRATION BUILDING | 4                                     |
| 9      | PE-V0-412-553-A102 | OPERATION & CONTROL PHILOSOPHY FOR AIR<br>CONDITIONING SYSTEM                                            | 12                                    |
| 10     | PE-V0-412-553-A103 | PRESSURE DROP CALCULATIONS FOR CHILLED<br>AND CONDENSER WATER PIPING                                     | 10                                    |
| 11     | PE-V0-412-553-A201 | TDS AND GA OF SCREW CHILLER ALONG WITH<br>FOUNDATION DETAILS                                             | 16                                    |
| 12     | PE-V0-412-553-A202 | TDS AND GA OF COOLING TOWER ALONG WITH<br>FOUNDATION DETAILS                                             | 15                                    |
| 13     | PE-V0-412-553-A203 | TDS AND GA OF AIR HANDLING UNITS ALONG<br>WITH FOUNDATION DETAILS                                        | 14                                    |
| 14     | PE-V0-412-553-A204 | TDS AND GA OF CONDENSER AND CHILLED<br>WATER PUMPS ALONG WITH FOUNDATION<br>DETAILS                      | 15                                    |
| 15     | PE-V0-412-553-A205 | TDS AND GA OF PAC / SPLIT AIR CONDITIONER                                                                | 12                                    |
| 16     | PE-V0-412-553-A206 | TDS AND GA OF MOTOR (PUMP, COOLING<br>TOWER, AHU)                                                        | 15                                    |
| 17     | PE-V0-412-553-A207 | TDS OF INSULATION MATERIAL (DUCT<br>INSULATION, DUCT LINING, PIPE INSULATION)                            | 12                                    |
| 18     | PE-V0-412-553-A208 | TDS AND GA OF FRESH AIR FANS                                                                             | 12                                    |
| 19     | PE-V0-412-553-A209 | TDS AND GA OF ONLINE NON CHEMICAL SCALE<br>PREVENTER                                                     | 16                                    |
| 20     | PE-V0-412-553-A210 | TDS AND GA OF WATER COOLED PACKAGE AC<br>UNITS ALONG WITH FOUNDATION DETAILS                             | 12                                    |
| 21     | PE-V0-412-553-A211 | TDS AND GA OF HEATERS AND HUMIDIFIER                                                                     | 7                                     |
| 22     | PE-V0-412-553-A212 | TDS AND GA OF FIRE DAMPER WITH ACTUATOR                                                                  | 10                                    |
| 23     | PE-V0-412-553-A213 | TDS AND GA OF FOR 3-WAY MIXING VALVE                                                                     | 8                                     |
| 24     | PE-V0-412-553-A214 | TDS AND GA OF VALVEES (BALANCING VALVE,<br>GATE VALVE, CHECK VALVE , Y ATRAINER)                         | 9                                     |
| 25     | PE-V0-412-553-A215 | TDS AND GA OF SUPPLY / RETURN AIR                                                                        | 8                                     |



**2x660MW ENNORE STPP  
AIRCONDITIONING SYSTEM  
MASTER DRAWING LIST WITH SCHEDULE  
OF SUBMISSION**

**SPECIFICATION No: PE-TS-412-553-A001**

**SECTION : I**

**SUB-SECTION : C6**

**REV 00**      **DATE: Feb 2017**

**SHEET 3 OF 4**

| S. NO. | DRAWING NO         | DRG./ DOC. TITLE                                                                                                                                                                      | SCH. WEEK<br>(FROM<br>DATE OF<br>LOI) |
|--------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
|        |                    | DIFFUSER/GRILL                                                                                                                                                                        |                                       |
| 26     | PE-V0-412-553-A216 | TDS OF GI SHEET                                                                                                                                                                       | 5                                     |
| 27     | PE-V0-412-553-A217 | TDS OF PIPES                                                                                                                                                                          | 5                                     |
| 28     | PE-V0-412-553-A218 | TDS AND GA OF EXPANSION TANK, MAKEUP<br>WATER AND SOFT WATER TANK                                                                                                                     | 5                                     |
| 29     | PE-V0-412-553-A219 | TDS AND GA OF FILTERS                                                                                                                                                                 | 10                                    |
| 30     | PE-V0-412-553-A220 | TDS FOR INSTRUMENTS ( PRESSURE GAUGE,<br>TEMPERATURE GAUGE, LEVEL GAUGE, PRESSURE<br>SWITCH, TEMPERATURE SWITCH, LEVEL SWITCH,<br>DP SWITCH, TEMPERATURE AND HUMIDITY<br>SENSORS ETC) | 12                                    |
| 31     | PE-V0-412-553-A501 | PID FOR MAIN PLANT, SERVICE,ADMIN BUILDING,<br>ESP ETC                                                                                                                                | 8                                     |
| 32     | PE-V0-412-553-A502 | TYPICAL DETAILS DUCT FABRICATION DRAWING<br>/ SUPPORT / ERECTION. INSULATION OF<br>DUCTING / PIPING & EQUIPMENTS CHILLED AND<br>CONDENSER WATER PIPE ERECTION                         | 7                                     |
| 33     | PE-V0-412-553-A503 | AC DUCT LAYOUT DRAWING FOR CONTROL ROOM<br>ARES AT 17M ALONG WITH AHU ROOM LAYOUT<br>WITH FOUNDATION DETAILS                                                                          | 16                                    |
| 34     | PE-V0-412-553-A504 | AC DUCT & AHU ROOM LAYOUT WITH<br>FOUNDATION DETAIL FOR UPS BATTERY<br>CHARGER ROOM AT 8.5M AND SWAS ROOM AT 0<br>M                                                                   | 17                                    |
| 35     | PE-V0-412-553-A505 | AC DUCT LAYOUT DRAWING FOR ESP CONTROL<br>ROOM ARES ALONGWITH AHU/PU ROOM LAYOUT<br>WITH FOUNDATION DETAILS FOR INDOOR AND<br>OUTDOOR UNITS                                           | 18                                    |
| 36     | PE-V0-412-553-A506 | AC DUCT LAYOUT DRAWING FOR SERVICE<br>BUILDING WITH AHU ROOM LAYOUT AND<br>FOUNDATION DETAILS                                                                                         | 18                                    |
| 37     | PE-V0-412-553-A507 | AC DUCT LAYOUT DRAWING FOR<br>ADMINISTRATION BUILDING WITH AHU ROOM<br>LAYOUT AND FOUNDATION DETAILS                                                                                  | 18                                    |
| 38     | PE-V0-412-553-A508 | AC PLANT ROOM LAYOUT & COOLING TOWER<br>AREA LAYOUT WITH COMPLETE FOUNDATION<br>DETAIL OF ALL EQUIPMENT                                                                               | 15                                    |
| 39     | PE-V0-412-553-A509 | CHILLED & CONDENSER WATER PIPING LAYOUT<br>WITHIN PLANT ROOM & UPTO VARIOUS AHU<br>ROOMS, & COOLING TOWER AREA FOR POWER                                                              | 20                                    |

Anshul

S A Khan

Praveen Kishore



**2x660MW ENNORE STPP  
AIRCONDITIONING SYSTEM  
MASTER DRAWING LIST WITH SCHEDULE  
OF SUBMISSION**

**SPECIFICATION No: PE-TS-412-553-A001**  
**SECTION : I**  
**SUB-SECTION : C6**  
**REV 00      DATE: Feb 2017**  
**SHEET 4 OF 4**

| S. NO. | DRAWING NO         | DRG./ DOC. TITLE                                                                                                                               | SCH. WEEK<br>(FROM<br>DATE OF<br>LOI) |
|--------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
|        |                    | HOUSE.                                                                                                                                         |                                       |
| 40     | PE-V0-412-553-A510 | CHILLED & CONDENSER WATER PIPING LAYOUT WITHIN PLANT ROON & UPTO VARIOUS AHU ROOMS, & COOLING TOWER AREA FOR ADMINISTRATION BUILDING.          | 20                                    |
| 41     | PE-V0-412-553-A511 | CHILLED & CONDENSER WATER PIPING LAYOUT WITHIN PLANT ROON & UPTO VARIOUS AHU ROOMS, & COOLING TOWER AREA FOR SERVICE BUILDING.                 | 20                                    |
| 42     | PE-V0-412-553-A512 | SPLIT AC SCHEDULE ALONGWITH HEAT LOAD CALCULATION FOR AUXILIARY BUILDING                                                                       | 22                                    |
| 43     | PE-V0-412-553-A701 | TDS OF PLC WITH CONFIGURATION DIAGRAM, BILL OF MATERIAL, GA & INTERNAL WIRING DIAGRAM, LOGIC FLOW DIAGRAM, IO WIRING DIAGRAM , PLC ROOM LAYOUT | 20                                    |
| 44     | PE-V0-412-553-A702 | I/O LIST FOR AC SYSTEM                                                                                                                         | 20                                    |
| 45     | PE-V0-412-553-A751 | ELECTRICAL FEEDER LIST                                                                                                                         | 18                                    |
| 46     | PE-V0-412-553-A752 | CABLE SCHEDULE                                                                                                                                 | 22                                    |
| 47     | PE-V0-412-553-A901 | PG TEST PROCEDURE                                                                                                                              | 12                                    |
| 48     | PE-V0-412-553-A902 | O&M MANUAL                                                                                                                                     | 25                                    |

**Note:**

The above is not the complete list and may change during detail engineering



**2x660MW ENNORE STPP  
AIR CONDITIONING SYSTEM**

**SPECIFICATION No: PE-TS-412-553-A001**

**SECTION : I**

**SUB-SECTION : C6**

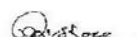
**REV 01**

**DATE: Feb 2017**

**SECTION-I**  
**SUB-SECTION-C6**  
**ANNEXURE-VII**  
**PID**  
**DRAWING**

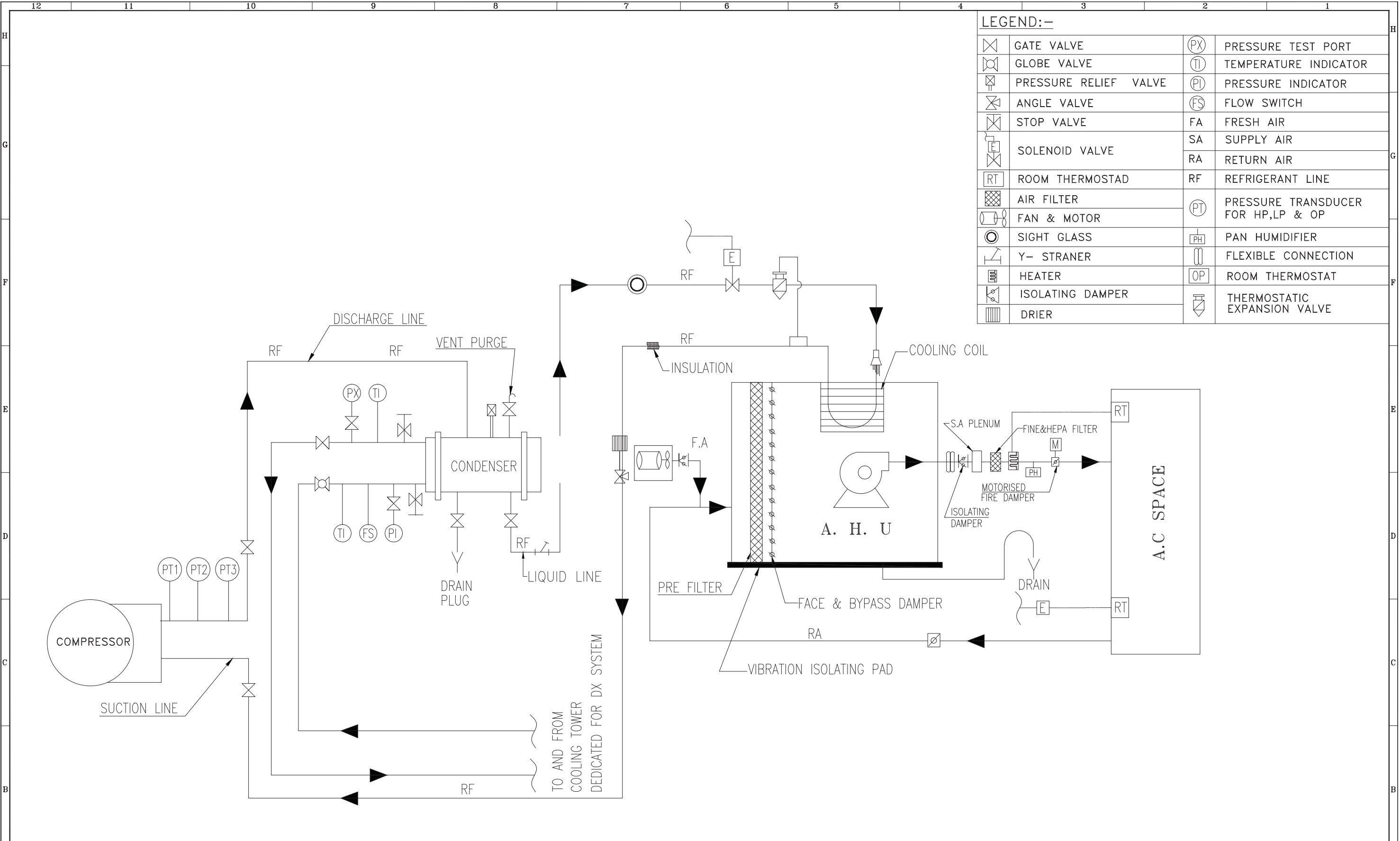
  
Anshul

  
S A Khan

  
Praveen Kishore



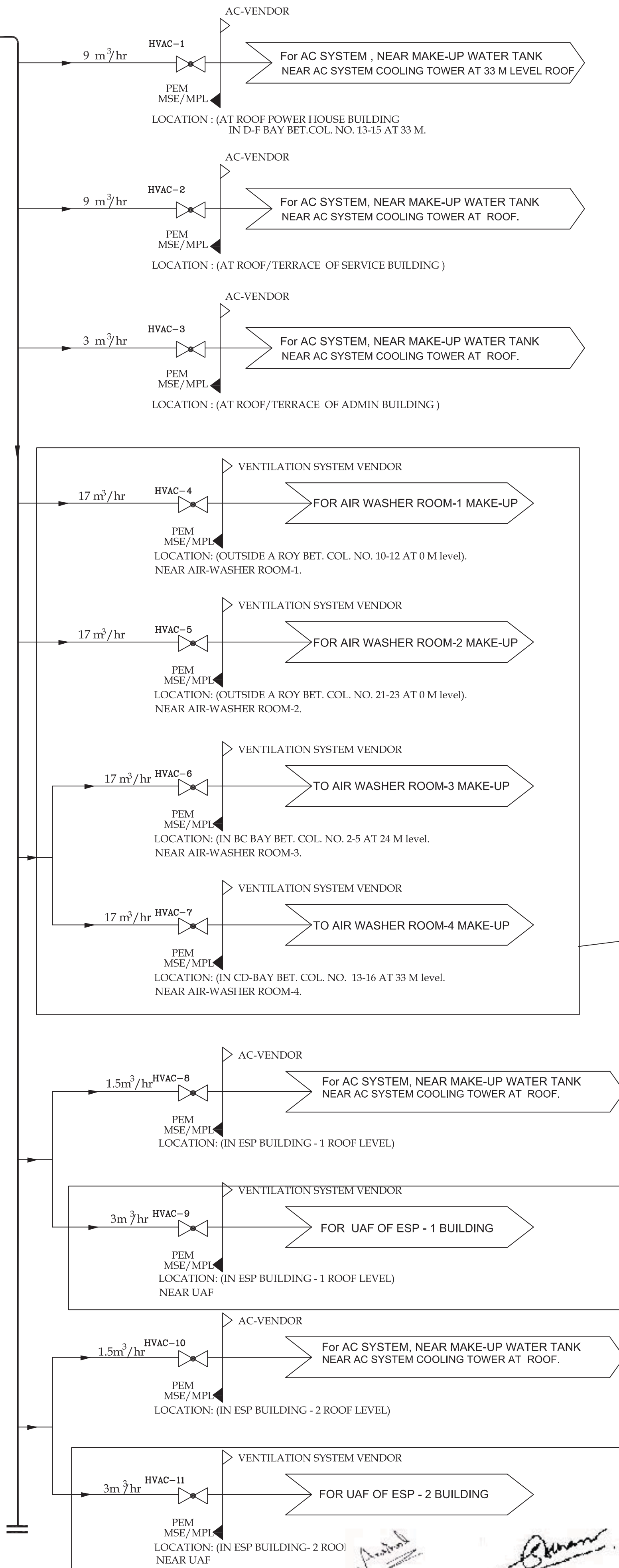




| LEGEND:- |                       |    |                                    |
|----------|-----------------------|----|------------------------------------|
|          | GATE VALVE            |    | PRESSURE TEST PORT                 |
|          | GLOBE VALVE           |    | TEMPERATURE INDICATOR              |
|          | PRESSURE RELIEF VALVE |    | PRESSURE INDICATOR                 |
|          | ANGLE VALVE           |    | FLOW SWITCH                        |
|          | STOP VALVE            | FA | FRESH AIR                          |
|          | SOLENOID VALVE        | SA | SUPPLY AIR                         |
|          |                       | RA | RETURN AIR                         |
|          | ROOM THERMOSTAD       | RF | REFRIGERANT LINE                   |
|          | AIR FILTER            |    | PRESSURE TRANSDUCER FOR HP,LP & OP |
|          | FAN & MOTOR           |    | PAN HUMIDIFIER                     |
|          | SIGHT GLASS           |    | FLEXIBLE CONNECTION                |
|          | Y- STRANER            |    | ROOM THERMOSTAT                    |
|          | HEATER                |    | THERMOSTATIC EXPANSION VALVE       |
|          | ISOLATING DAMPER      |    |                                    |
|          | DRIER                 |    |                                    |

| FOR BID PURPOSE ONLY |  |  |                                                                                                                                                                                                                                                                                                                                                                                           |  |  |                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |                                                                                                                                                              |  |  |
|----------------------|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| REFERENCE DRAWINGS.  |  |  | NOTES                                                                                                                                                                                                                                                                                                                                                                                     |  |  | NOTICE                                                                                                                                                                                                                                                                                                                                                                                              |  |  | DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA                                                                                                                |  |  |
|                      |  |  | 1. DO NOT SCALE, ASK WHEN IN DOUBT.<br>2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.<br>3. INSTRUMENTS/ANALYZERS INDICATED IN FLOW DIAGRAM ARE MINIMUM HOWEVER ANY ADDITIONAL REQUIREMENTS REGARDING QUANTITIES & TYPE OF INSTRUMENTS SHALL BE FINALIZED BY OWNER DURING DETAILED ENGINEERING AS PER PROCESS & REDUNDANCY REQUIREMENTS AS STIPULATED IN THE SPECIFICATION. |  |  | THIS DRAWING IS THE PROPERTY OF DESEIN PRIVATE LIMITED, NEW DELHI, AND IS LENT SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF, DIRECTLY OR INDIRECTLY, IT SHALL NOT BE USED TO FURNISH ANY INFORMATION FOR THE MAKING OF DRAWINGS, APPARATUS, OR PARTS THEREOF EXCEPT FOR THE PROJECT SPECIFICALLY PROVIDED FOR BY CONTRACT AGREEMENT WITH DESEIN. |  |  | CLIENT: TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION<br>PROJECT: 2x660 MW ENMORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI |  |  |
|                      |  |  |                                                                                                                                                                                                                                                                                                                                                                                           |  |  |                                                                                                                                                                                                                                                                                                                                                                                                     |  |  | TITLE :- FLOW DIAGRAM<br>DX TYPE AIR CONDITIONING SYSTEM                                                                                                     |  |  |
|                      |  |  |                                                                                                                                                                                                                                                                                                                                                                                           |  |  |                                                                                                                                                                                                                                                                                                                                                                                                     |  |  | JOB. No. D-4023                                                                                                                                              |  |  |
|                      |  |  |                                                                                                                                                                                                                                                                                                                                                                                           |  |  |                                                                                                                                                                                                                                                                                                                                                                                                     |  |  | DWG.No. 111-15-6202                                                                                                                                          |  |  |
|                      |  |  |                                                                                                                                                                                                                                                                                                                                                                                           |  |  |                                                                                                                                                                                                                                                                                                                                                                                                     |  |  | REV. 0                                                                                                                                                       |  |  |
|                      |  |  |                                                                                                                                                                                                                                                                                                                                                                                           |  |  |                                                                                                                                                                                                                                                                                                                                                                                                     |  |  | Sheet No. of 0                                                                                                                                               |  |  |

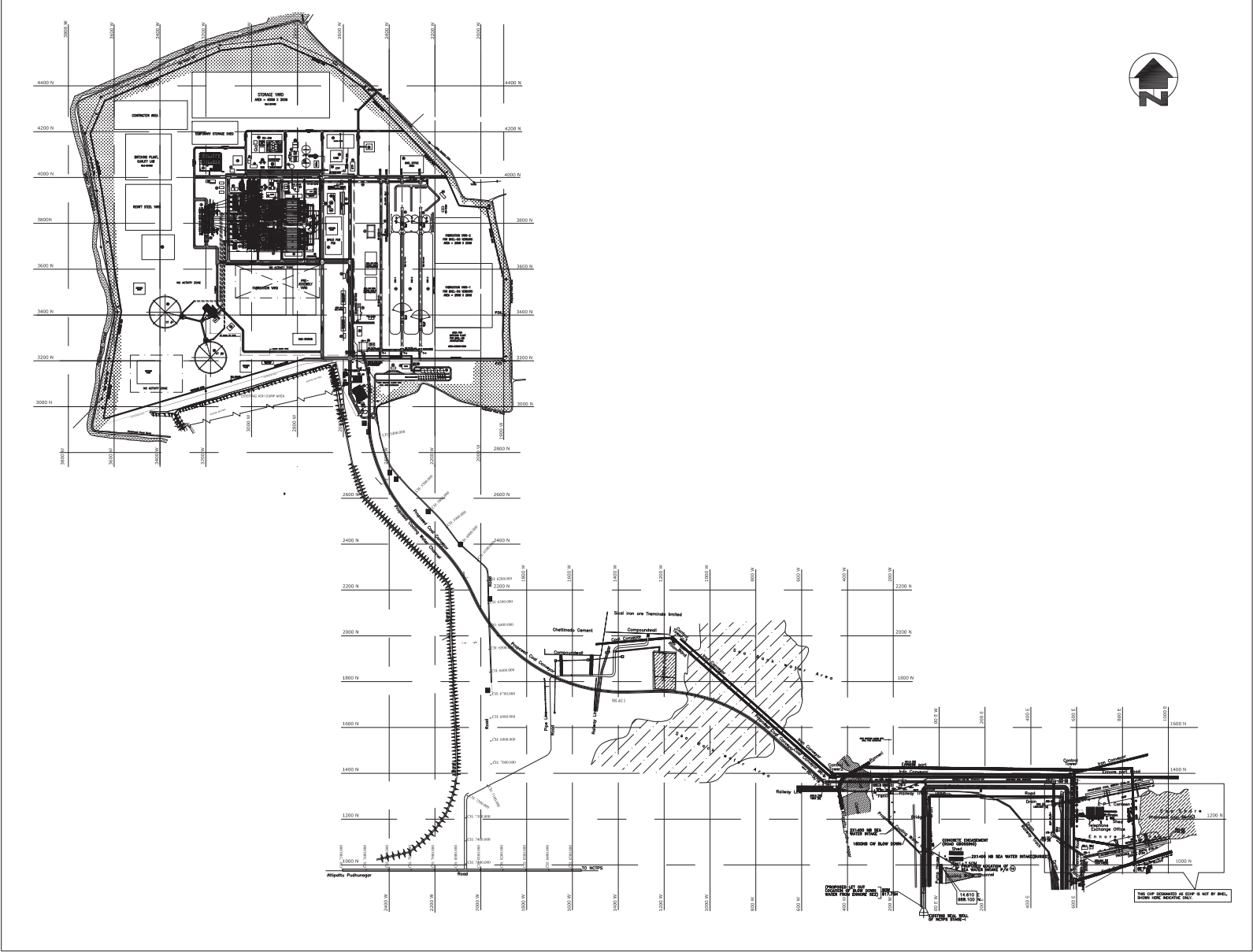
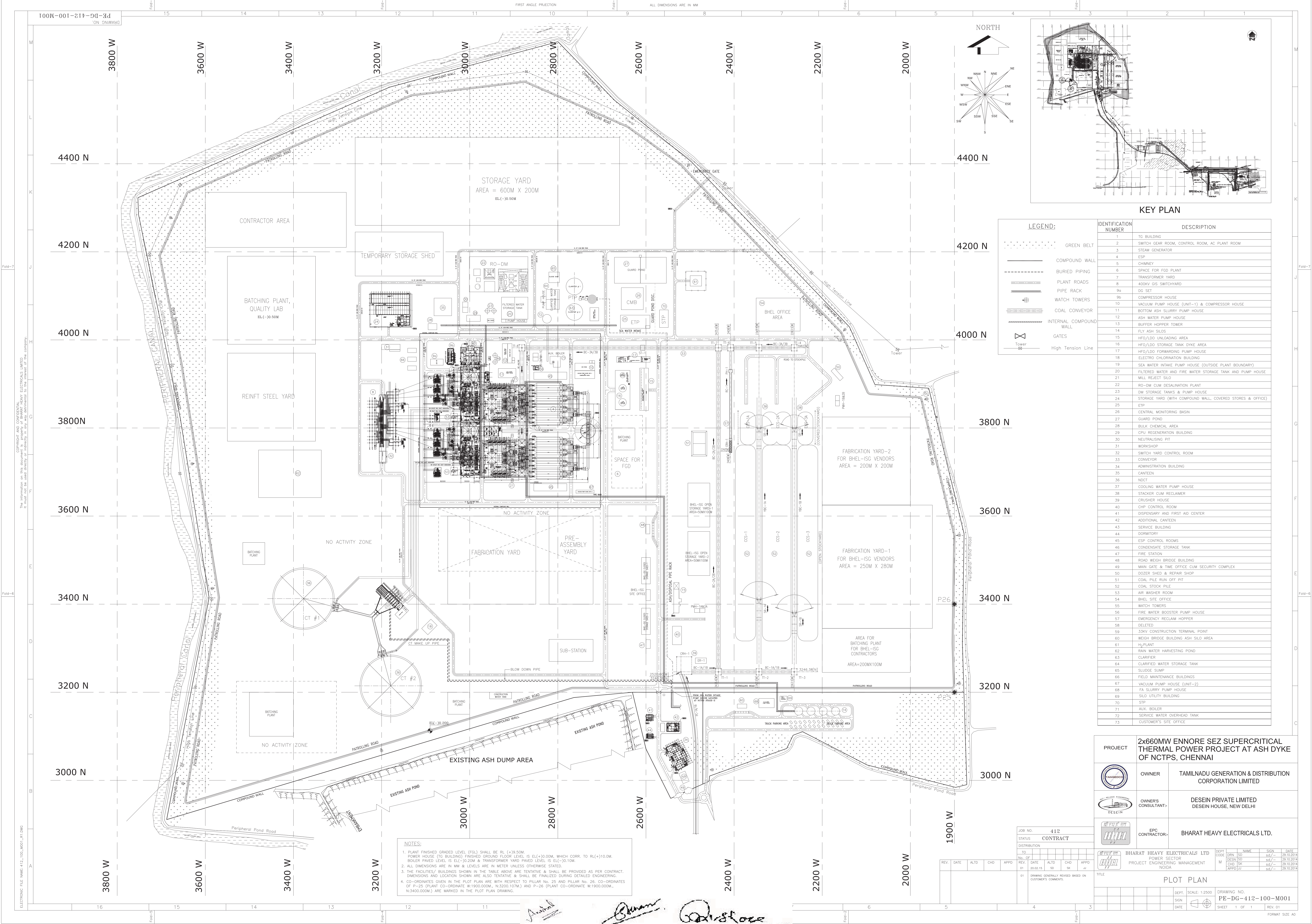
HVAC MAKE-UP (Clarified water)  
FOR HVAC MAKE-UP  
DISTRIBUTION AT VARIOUS  
PLACES AND TERMINAL POINT  
AS SHOWN IN DRG.



1. MPL TO PROVIDE HVAC MAKE-UP WATER PIPING/FITTINGS UP TO THE TERMINAL POINT AS SHOWN IN DRG.
2. HVAC MAKE-UP WATER PIPING INCLUDING FITTINGS SHALL BE TERMINATED WITHIN THE RANGE OF 5 METER DISTANCE FROM MAKE-UP WATER TANK / AIR-WASHER BY MPL (LP PIPING VENDOR'S SCOPE) FURTHER PIPING SHALL BE DONE BY RESPECTIVE PLANT SUPPLIER AS MARKED IN THIS DRG.
3. THE HVAC MAKE-UP WATER ISOLATING VALVES AS PER VALVE SCHEDULE SHALL BE ARRANGED BY MPL (VALVE GROUP) AS PER THE SCHEME AS MARKED IN TGHE DRG.
4. HVAC MAKE-UP WATER PRESSURE at EACH TERMINAL POINT SHALL BE MAINTAINED 0.5 kg/cm2.
5. AC - SYSTEM MAKE-UP WATER PIPING FROM TERMINAL POINT TO MAKE-UP WATER TANK, COOLING TOWER, EXPANSION TANK & PAN HUMIDIFIER SHALL BE IN BIDDER'S SCOPE.
6. MAKE-UP WATER REQUIREMENT IS CONTINUOUS.

## APPLICABLE FOR VENTILATION SYSTEM

|  |  |  |  |  |       |                                                                                       |                     |        |        |
|--|--|--|--|--|-------|---------------------------------------------------------------------------------------|---------------------|--------|--------|
|  |  |  |  |  | DEPT. | SCALE                                                                                 | DRAWING NO.         |        |        |
|  |  |  |  |  | SIGN  |  | PE-DG-412-553-A055. |        |        |
|  |  |  |  |  | DATE  |                                                                                       | SHEET               | 1 OF 1 | REV 01 |



KEY PLAN

| LEGEND: |                        |
|---------|------------------------|
|         | GREEN BELT             |
|         | COMPOUND WALL          |
|         | BURIED PIPING          |
|         | PLANT ROADS            |
|         | PIPE RACK              |
|         | WATCH TOWERS           |
|         | COAL CONVEYOR          |
|         | INTERNAL COMPOUND WALL |
|         | GATES                  |
|         | Tower                  |
|         | High Tension Line      |

| IDENTIFICATION NUMBER | DESCRIPTION                                                |
|-----------------------|------------------------------------------------------------|
| 2                     | TO BUILDING                                                |
| 3                     | SWITCH GEAR ROOM, CONTROL ROOM, AC PLANT ROOM              |
| 4                     | STEAM GENERATOR                                            |
| 5                     | ESP                                                        |
| 6                     | CHIMNEY                                                    |
| 7                     | SPACE FOR FGD PLANT                                        |
| 8                     | TRANSFORMER YARD                                           |
| 9a                    | 400KV GIS SWITCHYARD                                       |
| 9b                    | DS SET                                                     |
| 10                    | COMPRESSOR HOUSE                                           |
| 11                    | VACUUM PUMP HOUSE (UNIT-1) & COMPRESSOR HOUSE              |
| 12                    | BOTTOM ASH SLURRY PUMP HOUSE                               |
| 13                    | ASH WATER PUMP HOUSE                                       |
| 14                    | BUFFER HOPPER TOWER                                        |
| 15                    | FLY ASH SILOS                                              |
| 16                    | HFO/LDO UNLOADING AREA                                     |
| 17                    | HFO/LDO FORWARDING PUMP HOUSE                              |
| 18                    | ELECTRO CHLORINATION BUILDING                              |
| 19                    | SEA WATER INTAKE PUMP HOUSE (OUTSIDE PLANT BOUNDARY)       |
| 20                    | FILTERED WATER AND FIRE WATER STORAGE TANK AND PUMP HOUSE  |
| 21                    | MILL REJECT SILO                                           |
| 22                    | RO-DM CUM DESALINATION PLANT                               |
| 23                    | DM STORAGE TANKS & PUMP HOUSE                              |
| 24                    | STORAGE YARD (WITH COMPOUND WALL, COVERED STORES & OFFICE) |
| 25                    | ETP                                                        |
| 26                    | CENTRAL MONITORING BASIN                                   |
| 27                    | GUARD POND                                                 |
| 28                    | BULK CHEMICAL AREA                                         |
| 29                    | CPU REGENERATION BUILDING                                  |
| 30                    | NEUTRALISING PIT                                           |
| 31                    | WORKSHOP                                                   |
| 32                    | SWITCH YARD CONTROL ROOM                                   |
| 33                    | CONVEYOR                                                   |
| 34                    | ADMINISTRATION BUILDING                                    |
| 35                    | CANTEEN                                                    |
| 36                    | NDC                                                        |
| 37                    | COOLING WATER PUMP HOUSE                                   |
| 38                    | STACKER CUM RECLAIMER                                      |
| 39                    | CRUSHER HOUSE                                              |
| 40                    | DWP CONTROL ROOM                                           |
| 41                    | DISPENSARY AND FIRST AID CENTER                            |
| 42                    | ADDITIONAL CANTEEN                                         |
| 43                    | SERVICE BUILDING                                           |
| 44                    | DORMITORY                                                  |
| 45                    | ESP CONTROL ROOMS                                          |
| 46                    | CONDENSATE STORAGE TANK                                    |
| 47                    | FIRE STATION                                               |
| 48                    | ROAD WEIGH BRIDGE BUILDING                                 |
| 49                    | MAIN GATE & TIME OFFICE CUM SECURITY COMPLEX               |
| 50                    | DOZER SHED & REPAIR SHOP                                   |
| 51                    | COAL PILE RUN OFF PIT                                      |
| 52                    | COAL STOCK PILE                                            |
| 53                    | AIR WASHER ROOM                                            |
| 54                    | BHEL SITE OFFICE                                           |
| 55                    | WATCH TOWERS                                               |
| 56                    | FIRE WATER BOOSTER PUMP HOUSE                              |
| 57                    | EMERGENCY RECLAIM HOPPER                                   |
| 58                    | DELETED                                                    |
| 59                    | 33KV CONSTRUCTION TERMINAL POINT                           |
| 60                    | WEIGH BRIDGE BUILDING ASH SILO AREA                        |
| 61                    | H <sub>2</sub> PLANT                                       |
| 62                    | RAIN WATER HARVESTING POND                                 |
| 63                    | CLARIFIER                                                  |
| 64                    | CLARIFIED WATER STORAGE TANK                               |
| 65                    | SLUDGE SUMP                                                |
| 66                    | FIELD MAINTENANCE BUILDINGS                                |
| 67                    | VACUUM PUMP HOUSE (UNIT-2)                                 |
| 68                    | FA SLURRY PUMP HOUSE                                       |
| 69                    | SLO UTILITY BUILDING                                       |
| 70                    | STP                                                        |
| 71                    | AUX. BOILER                                                |
| 72                    | SERVICE WATER OVERHEAD TANK                                |
| 73                    | CUSTOMER'S SITE OFFICE                                     |

NOTES:

1. PLANT FINISHED GRADED LEVEL (FGL) SHALL BE RL (+)9.50M.
2. POWER HOUSE (TO BUILDING) FINISHED GROUND LEVEL IS EL(+10.00M, WHICH CORR. TO RL(+10.00M, BOILER PAVED LEVEL IS EL(-)0.20M & TRANSFORMER YARD PAVED LEVEL IS EL(-)0.10M.
3. ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METER UNLESS OTHERWISE STATED.
4. THE FACILITIES/ BUILDINGS SHOWN IN THE TABLE ABOVE ARE TENTATIVE & SHALL BE PROVIDED AS PER CONTRACT. DIMENSIONS AND LOCATION SHOWN ARE ALSO TENTATIVE & SHALL BE FINALIZED DURING DETAILED ENGINEERING.
5. CO-ORDINATES GIVEN IN THE PLOT PLAN ARE WITH RESPECT TO PILLAR NO. 25 AND PILLAR NO. 26. CO-ORDINATES OF P-25 (PLANT CO-ORDINATE W-1900.000M, N-3200.077M) AND P-26 (PLANT CO-ORDINATE W-1900.000M, N-3400.000M) ARE MARKED IN THE PLOT PLAN DRAWING.

JOB NO. 412

STATUS CONTRACT

DISTRIBUTION

| REV. | DATE     | ALTD | CHD | APPD    |
|------|----------|------|-----|---------|
| 01   | 20.02.15 | SD   | SK  | APPD JJ |

BHARAT HEAVY ELECTRICALS LTD

POWER SECTOR ENGINEERING MANAGEMENT NOIDA

DEPT CODE SD

NAME SD

SIGN SD

DATE 28.10.2014

DEPT CODE M

NAME SD

SIGN SD

DATE 28.10.2014

TITLE

PLOT PLAN

DEPT SCALE: 1:2500

SIGN

DATE

DRAWING NO. PE-DG-412-100-M001

SHEET 1 OF 1

REV. 01

FORMAT SIZE A0

Anshul  
S A Khan  
Praveen Kishore

