NTPC LIMITED

RAMAGUNDAM SUPER THERMAL POWER STATION STAGE-I (3x200 MW) R&M OF ESP PACKAGE)

TECHNICAL SPECIFICATION

FOR

HVAC SYSTEM

SPECIFICATION NO.: - PE-TS-448-571-15000A-A002 (REV-00)

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

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This Technical specification consists of two sections:

SECTION - I

SECTION - II

SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION

1.0 INTENT OF SPECIFICATION

1.1 The specification covers Supply part and Mandatory spares , comprising of submission of O&M manuals, manufacture, fabrication,, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables, mandatory spares along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order for RAMAGUNDAM STPS (R&M) STAGE-I (3x200MW).

1.2 The contractor shall be responsible for providing all material & equipment, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **HVAC SYSTEM.**

1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all terms required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.

1.5 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under section II of the specification **within 10 days of receipt of tender documents.** In absence

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

1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the format attached with GCC (Annexure-II Deviation sheet (Cost of withdraw), otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.

1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, Section - C shall prevail over section – D, however more stringent requirement as per the interpretation of the owner shall apply.

1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser Employer, consultant, please referred relevant clause of General Conditions of Contract (GCC).

SECTION: I
Sub Section: B

PROJECT INFORMATION

NTPC Ramagundam (RSTPS) is a pit head thermal power station based on the coal supplied from the nearby Singareni Mines of M/s. SCCL and water from Pochampad Dam. The station is located in the Karimnagar district about 60Kms from Karimnagar town and 100kms from Warangal. Ramagundam Railway station is on Delhi-Chennai main line. Ramagundam is well connected to Hyderabad by Rajiv Rahadari state highway.

NTPC intends taking up Renovation and Modernization work on these existing ESP's of (3x200) MW units, along with on refurbishing the existing ESPs and augmenting the collection area. This specification is intended for such R&M of three (03) sets Electrostatic Precipitators of 3x200 MW units of RSTPS.

The current work involves renovation of the ESPs at Site which is being executed by BHEL. The bidder's scope pertains to the supply of the air-conditioning and ventilation system as per the details specified elsewhere in the specification.

SECTION: I

SUB-SECTION: C 1

SPECIFIC TECHNICAL REQUIREMENT

1. FUNCTION

The purpose of the system is to Supply HVAC equipment for 3 X 200 MW STAGE-I ESP R&M NTPC RAMGUNDAM for ESP Control Rooms.

2. SYSTEM DESCRIPTION

Engineering of Air Conditioning System such as Heat load, P&ID and capacities of equipment have already been finalized with customer.
Equipment /Layout drawings for specific makes of respective equipment (as per Table 1) have been finalized and are attached with this specification. Bidder has to procure various items from the makes for which the documents are already approved. Thus, bidder is not required to submit these drawings/documents afresh. However, bidder shall be required to endorse the documents attached with the specification during detail engineering.
However, in exception case where any approved make denies supply of respective item due to reasons beyond control of the bidder, bidder may propose change of make of such item (to be necessarily selected from the approved list of makes of sub-supplier items, attached with this specification), acceptance of which shall be subject to BHEL/ customer approval.

In such a scenario, Bidder will have to submit Engineering document for such items in line with details mentioned in respective equipment GA / documents attached at Appendix 1 and the Technical specification of the equipment. However, any data which is proprietary in nature or standard for the model offered by OEM or not specifically insisted in this tender specification of the respective equipment may be updated/ modified suitably.

Table -1

Item	Make
Air Cooled Package AC	VOLTAS
Drain Pipe	JINDAL
Temp + RH Sensor	HONEYWELL
Air Flow Switch	HONEYWELL
Gate Valve	HONEYWELL
GIU Based Control System	SATS Automation

3. SCOPE OF SUPPLIES

a) Two (2 nos.) Air cooled Package AC (1W+1SB) of 15 TR Capacity(Actual), along with indoor and outdoor units, piping, insulation, cabling, etc. for the AC area of each unit.

b) Supporting brackets with mounting frame for following wall mounted supply fans of 30mmwc static pressure –
- 6 Nos. of fans of Capacity 7,500 CMH
- 3 Nos. of fans of Capacity 10,000 CMH

c) MS rain protection cowl with bird screen for following wall mounted fans –
- 6 Nos. of exhaust fans of Capacity 4,500 CMH
- 3 Nos. of exhaust fans of Capacity 6,000 CMH
- 9 Nos. of propeller fans of Capacity 1200 CMH

d) GIU based control System

e) 40 NB GI medium class INSULATED DRAIN WATER PIPING from various equipment like PACs etc. up to nearest available drain point with necessary fittings like tees, reducers, expanders, elbows, flanges, valves with flanges, U trap etc. as per specifications.

f) FIELD INSTRUMENTS required for local monitoring & control for HVAC System –

4.1*	Differential Pressure Switch	6	Nos.
4.2*	Air Flow Switch	6	Nos.
4.3*	Gyserstat	3	Nos.
4.4*	Temp + RH Sensor	3	Nos.
4.5*	Airstat	3	Nos.
4.6*	25 NB Gate Valve	9	Nos.

4. EQUIPMENT DETAILS (if different make is chosen for respective equipment)

4.1. **AIR COOLED PACKAGE AIR CONDITIONER**

Air cooled Package A/C units shall be planned for all the Control Panel Areas/ AC Areas marked in the drawings. All the split A/C units shall be provided with dedicated condenser unit (Outdoor unit).

The Bidder shall submit necessary layout drawings for all the systems showing equipment's marked. The bidder shall also submit schematic/P&ID and overall layout drawings for all the systems.

Air cooled Package Split Air Conditioning units consisting of:

Hermetic Compressor with Air cooled condenser

- Evaporator Cooling coil, blower unit and refrigerant circuit
- Refrigerant pipeline with insulation
- Drain pipeline
- Power and control cables
- Suitable capacity stabilizer
- MCB/PDB
- Handheld remote with remote holder

The Package AC unit shall have one condenser (outdoor) unit and one Evaporator (indoor) unit to suit the control rooms. The capacity (TR) of the indoor unit shall be the actual capacity (100%) as the split units are intended to be used. Outdoor units shall comprise of compressor, cooling fan, condenser. Indoor unit comprising of blower, filter, cooling coil shall be mounted in attractive, corrosion resistant enclosures. The compressor shall be of hermetic scroll / rotary type. The contractor shall indicate the safety measures provided for the compressor and motor. The condenser shall be air cooled copper coil with Aluminum fins type with ample condensing surface. The cooling coil shall be of direct expansion type with copper tubes and mechanically bonded aluminum fins; it shall be sufficiently deep for effective cooling. The refrigerant circuit between (outdoor) Condenser unit and (indoor) Evaporator unit shall be carried out as per site conditions. The circuit shall include thermostatic expansion valve/ linear expansion valve, filter drier and liquid line shut off valve. It shall be protected by Hi-Lo pressure start. Fan shall be provided to handle the conditioned air. The fan shall be dynamically balanced and its operation shall be smooth and quiet. It shall be complete with direct drive motor. The bearings shall be self-lubricating type.

4.2. For details of GIU based Control system and Instruments refer relevant clause of C&I Specification.

5. GENERAL

1) Documents like data sheet/ technical particulars etc. are subject to Customer approval during detail engineering stage.

2) All drawings and documents shall be computer based.

3) All commissioning spares & consumables for trouble free operation till handing over, shall be provided.

4) Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL approval during detail engineering stage. Standard QP format is enclosed in the technical specification.

5) Indicative list of makes is enclosed however this equipment / items shall be subject to Customer & BHEL approval during detail engineering Stage.

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

7) In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.

8) Bidder to note that BHEL reserve the right for drg/doc submission through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Bidder to ensure proper internet connectivity at their end.

9) Quality requirements in the Technical specification are minimum requirements for inspection and testing. Vendor to note that quality plans are subject to Customer approval during detail engineering stage. Standard QP format is enclosed in the technical specification.

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

11) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.

12) The bidder's proposal shall be for equipment in accordance with the tech. specification.

13) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification during detail engineering

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

6. CODES AND STANDARDS

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

IS-659: Safety code for air-conditioning

IS-660: Safety code for mechanical refrigeration

ASHRAE-23: Standard method of testing and rating [67 Standards] air conditioner.

ARI-450-6: Standards for water cooled refrigerant Condenser.

ASME Sec. VII: Unfired pressure vessels

IS-4503: Shell and tube type heat exchanger.

ASHRAE 22-72: Method of testing for rating water cooled refrigerant condenser.

ASHRAE-15-2007: Safe Standard for Refrigeration System

ASHRAE-30-1995: Method of testing liquid chilling packages

ANSI-8-31.5: Refrigeration piping.

ANSI-8-9.: Safety code for mechanical refrigeration.

AR1-410 : Standard for air cooling and air heating coils.

AR1-210: Standard for unitary air conditioning equipment.

IS-3588: Specification for electrical axial flow fans.

AMCA-210: Methods of performance test for fans.

BS-2831: Methods of test for air filters used in AC and general ventilation.

IS-4671: Expanded polystyrene for thermal insulation purpose.

IS-702: Industrial bitumen

IS-1239: Heavy class Pipes for sizes up to 150 mm dia.

IS-8188: For Water conditioning

IS-325: 3 phase induction motors

IS-4029: Guide line for testing 3 phase induction motor

IS-210: Specification grey iron casting

IS-2062: Structural steel

AMCA - Bulletin: Standard code of testing centrifugal and axial flow fans No. 210

IS-2825: Code of practice for welding mild steel

IS-2676: Dimensions for wrought aluminium and aluminium alloy sheets and strips.

ASHRAE Code: For various filter

ASHRAE-62-2004: Ventilation rates

IS-655: Specification for metal air ducts

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

SECTION: I

SUB-SECTION: C-2

CUSTOMER SPECIFICATION

1.00.00 **GENERAL**

1.01.00 Complete air conditioning system and equipments shall be designed as per the Design Philosophy & Equipment specification elaborated below. Sizing calculations for all the equipments shall be submitted for approval of owner during the design phase.

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

2.00.00 **DESIGN PHILOSOPHY**

1. Design ambient conditions for all air conditioning system shall be as indicated below:

Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)
Summer	**45.0**	**27.0**
Monsoon	**35.8**	**28.3**
Winter	**35.0**	**25.0**

2. All equipments of Air Conditioning system shall be designed for continuous duty.
3. Air conditioned areas shall be maintained at 24 deg. C ± (plus or minus) 1 deg. C and relative humidity of 50% ± (plus or minus) 5%.
4. The fresh air quantity fresh air shall be minimum 1.5 air changes per hour. Fresh air fan capacity shall be minimum 10% of the total CMH value of working indoor units.
5. Lighting load shall be 2 Watts/Sq. feet.
6. The occupancy shall be minimum one person per 25 Sq.M (Minimum).
7. In Air conditioning system the return air shall be through ducts and use of plenum space for return air shall be avoided.
8. The supply and return air ducts shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls & floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts in control panel of A/C plant and further wiring upto fire alarm panels shall be done by Bidder. Closure of fire dampers shall raise an alarm in the system.

9. Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec. Air distribution system shall be sized to have a constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/sec.

10. Requirement of Underdeck Insulation (for A/C area)

    Underdeck insulation of 50 mm nominal thickness of glass wool (32 Kg/cu.m) or rock wool (48 Kg/cu.m) shall be provided if

    i) Non A/C area is located just above the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of A/C area.
    ii) Non A/C area is located just below the A/C area. In this case, underdeck insulation shall be provided underneath of the ceiling of Non A/C area.
    iii) Underneath the ceiling of AHU room located below the A/C area or in case AHU room is exposed to atmosphere.

11. A minimum design margin of ten (10) % shall be considered in design of A/C Plant Capacity.

12. Where A/C load is of the order of 25-60 TR, Direct Expansion (D-X) type Condensing unit shall be provided depending on the availability of space/ layout etc. For areas, where A/C load is of the order of 15-25TR, ductable split/packaged A/C shall be provided. Smaller areas which are away from the D-X type Condensing unit which may require air conditioning upto 15 TR rating shall be served with Hi-wall Split/Cassette air conditioner unitsof suitable for industrial uses as per requirement.

13. Split air conditioner shall conform to minimum three (3) star (*****) rating of latest version of Bureau of Energy Efficiency (BEE) HVAC code issued by Ministry of Power, Govt. of India.

14. Refrigerant suction, discharge/hot gas lines & liquid lines shall be sized such that the total pressure drop is equivalent to not more than 1.1 deg C in saturation temperature of refrigerants. However, refrigerant velocity shall not be greater than 0.5 m/sec in liquid line.

15. Noise level within the air conditional space shall be restricted to 35-45 NC level with suitable acoustic attenuation/ duct silencers/ acoustic insulation, etc.

16. Vibration isolator pads shall be provided with isolation efficiency of minimum 85%.

3.00.00 **EQUIPMENT DESCRIPTION – AIR CONDITIONING SYSTEM**

3.01.00 **Condensing Unit (Air-Cooled/Water cooled D-X type) (if applicable)**

Condensing unit

	Type	:	Air cooled scroll type
	Vibration isolators	:	Steel spring / Neoprene rubber cushy foot type with isolation efficiency not less than 85%.
	Compressor		
	Type	:	The Compressor shall be scroll, serviceable, either hermetic type or semi-hermetic type with automatic capacity control (minimum 3 steps).
	Type of drive	:	Motor driven, direct or through V-belt.
	Refrigerant	:	The refrigerant shall be R-134a/ R-410A/R-407C or any other environment friendly refrigerant.
	Accessories	:	High/Low pressure cutouts, oil pressure switches, relief valves, pressure gauges at each stage, lube oil and control oil pressure gauges, suction & discharge stop valves, Muffler, Crank case heaters, oil filters, magnetic oil separators, temperature indicators for lube oil/heaters, oil level indicators, safety thermostat for crank case heater, vibration isolators, etc.
	Motor Rating	:	10% more than the power required by the compressor at 50 deg C design ambient temperature.
	Capacity	:	Minimum capacity shall be suitable for the identified/selected at evaporating temperature and condensing temperature and shall be indicated.

3.02.00 **Air Handling Unit (AHU)**

3.02.01 Each AHU shall consist of casing, fan impeller section, cooling coil section, damper section, steel frame with anti vibration mountings (AVMs) having minimum 85% vibration dampening efficiency and flame retardant, water proof neoprene impregnated flexible connection on fan discharge. Isolation dampers at the suction and discharge of each AHU shall be provided, in case return air duct is directly connected to AHU. However, in case AHU room is used for return air, isolation dampers are required to be provided only at AHU discharge of each AHU. Pre-filter at the suction and fine (micro-vee type) and at the discharge of each individual AHU, and heater section in the common discharge of AHUs shall be provided.

3.02.02 The casing of AHUs shall be of double skin construction. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 0.63 mm (24g) galvanized steel sheet (thickness of galvanization as per manufacturer's standard) , with 25mm thick polyurethane foam insulation of minimum 38 Kg/Cum density in between. Suitable reinforcements shall be provided to give structural strength to prevent any deformation/buckling.

3.02.03 Sloping condensate drain pan shall be made of minimum 1.2 mm thick Stainless Sheet Steel. It shall be isolated from bottom floor panel through 25mm thick heavy

duty treated for Fire (TF) quality expanded polystyrene or polyurethane foam. Drain pan shall extend beyond the coil.

3.02.04 Cooling coil (min. 4 row deep) shall be made of seamless copper tubes with aluminium fins firmly bonded to copper tubes and shall be provided with suitable drains and vents connections.

3.02.05 All filter plenum shall be provided with a walking platform inside the plenum chamber for filter cleaning purpose. Inspection door shall be provided at the plenum chamber and a removable type ladder shall be attached to plenum.

3.02.06 **Centrifugal fan for AHU**

a)	Fan Type	:	Double Width Double Inlet (DWDI) Centrifugal Type
b)	Fan impeller	:	Backward curved blades
c)	Casing material	:	GI /Mild steel with minimum thickness of 3 mm.
d)	Impeller material	:	Carbon steel
e)	Shaft	:	EN 8 Steel
f)	Fan bearings	:	Self aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours.
g)	Critical speed	:	First critical speed of rotating assembly shall be at least 25% above the operating speed.
h)	Drive	:	Motor driven with removable belt guard.

3.04.00 **Pan Humidifier:**

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

3.05.00 HI-WALL SPLIT/CASSETTE/ AIR-CONDITIONERS

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

i) Casing

ii) Hermetically sealed rotary/scroll Compressor

iii) Condenser and condenser cooling fan

iv) Evaporator along with fan

v) Cooling coil

vi) Filters

vii) Piping, valves, refrigerant strainer, etc.

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

ix) Vibration isolator pads, etc as required.

x) The refrigerant shall be R-407C/ R-134a/ R-410A or any other environment friendly refrigerant

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

The housing of the unit shall be powder coated galvanized steel. All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view.

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

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

3.06.00 Packaged Air Conditioner:

PAC units shall be factory tested and assembled self contained units complete with refrigerant compressor, coils, fans, insulation and wiring. Various parts of PAC units wherever required shall be insulated with expanded polyethylene conforming to IS:4671. The PAC unit shall comprise of an evaporator (indoor air) blower section and an air cooled condenser (outdoor air) section. Heavy gauge steel cabinet finished with paint of approved colour, shall be used to house components of PAC. The evaporator and condenser coils shall be arranged for direct expansion cooling and shall be formed of aluminum fins mechanically bonded to seamless copper tubes and electrically tinned. The inter-connecting refrigerant circuits shall comprise of hermetically sealed scroll compressor and motor with all necessary isolation valves, with adjustable set point, sight glass, copper tubing and pipeline ancillaries. The condenser coils shall be air cooled by propeller type fans complete with safety guards. The condensing coils The evaporator air blower(s) shall be centrifugal forward curved type belt driven by individual motor(s) and suitable for the external static pressure. The fan assembly shall be isolated from the casing by anti-vibration mounts. The fan/motor drive shall be capable of capacity adjustment by pulley changes within +15% of design duty shall be suitably arranged to avoid radiant heat

pick-up from solar sources. Condenser capacity control shall be provided by means of fans and 'head pressure' sensing. High efficiency filters shall be provided in the main supply air duct before existing discharge duct.

A separate cubicle shall be provided within the overall casing to house the thermostatic controls, which shall be electric/electronic solid state, prewired and tested. The refrigerant system shall be protected by pressure limiting devices, electric and thermal overloads and unloading facilities to provide the required control range tolerances. A low voltage room thermostat or RTD based temperature sensing device shall be provided for wall mounting. The casing shall be fitted with all necessary coil drains and service connections/ entries. PAC units shall be selected manually and be ON/OFF switched. The units shall be fully packaged and incorporate integral room air sensing control thermostats and manufacturers work fitted safety interlocks. All controls shall be prewired to unit mounted control/power terminal boxes.

4.00.00 BALANCE EQUIPMENT SPECIFICATION

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

a) Refrigerant piping : : Seamless steel tubes conforming heavy grade IS:1239 or copper tubes as per IS:2501 (copper material as per IS:191 hard copper grade).

b) Drain piping : Same as (a) above & galvanized as per IS:4736.

c) Fittings

1) The steel fittings shall conform to ASTM A234 Gr. WPB and dimensional standard to ANSI B 16.9/ANSI B16.11 / equivalent for sizes 65 NB and above.

2) For sizes 50 NB and below, the material shall conform to ASTM A-105.

3) All steel flanges shall be of slip on type and shall conform to ANSI B 16.5

4) Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B31.5.

4.02.00 **VALVES**

i. Valves shall have full sizes port and suitable for horizontal and as well as vertical installation.

ii. Valves for regulating duty shall be of globe type suitable for controlling throughout its lift.

iii. All safety /relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.

iv. Valves shall be furnished with back seating arrangement for repacking while working under full working pressure.

v. All valves shall be supplied with companion flanges, nut, bolts & washers, etc.

vi. The refrigerant line valves shall have steel or brass body with TEFLON gland packing. The construction of disc shall be either globe or angle type. The valve seat shall have white metal lining or equivalent.

4.03.00 **Balancing / Controller Valves:**

The valves of sizes 32 mm to 65 mm dia shall be of gun metal / cast iron construction with screwed ends. Whereas valves of sizes 75 mm and above shall be of cast iron construction with internal parts of SS 410 and EPDM / nitrile seat with flanged ends.

4.03.00 **AIR FILTERS**

4.03.01 **Pre Filter**

1) Type : Flange / Cassette

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

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

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

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

c) Capable of being cleaned by water flushing.

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

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

4) **Efficiency :**

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

5) Minimum thickness : 50 mm

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

	7) Pressure drop	:	Initial pressure drop - Not to exceed 5.0 mm WC at rated flow. Final pressure drop - Upto 7.5 mm WC.
	8) Location	:	a) At the suction of each AHUs
		:	b) At the suction of each Fresh air fan

4.03.02 **Fine Filters (Microvee type)**

1)	Type	:	Flange / Cassette
2)	Fine filter shall contain washable non-woven synthetic fibre or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides.		
3)	Other requirements	:	a) A neoprene sponge rubber sealing shall be provided on either face of the filter frame. b) Capable of being cleaned by air or water flushing. c) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.
4)	Efficiency	:	Average arrestance > 90% when tested in accordance with BS:6540/ASHRAE–52-76 / EN-779.
5)	Minimum thickness	:	150 mm or 300 mm.
6)	Face Velocity	:	Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm.
7)	Pressure drop	:	Initial pressure drop - Not to exceed 10 mm WC at rated flow ; Final pressure drop-Up to 25 mm WC.
8)	Location	:	i) At the discharge of each individual AHU. ii) At the discharge of each Fresh air fan.

4.04.00 **LOW PRESSURE AIR DISTRIBUTION SYSTEM**

4.04.01 Material of air distribution system shall be through galvanized steel sheet and galvanizing shall be of 275 gms/sq.m. (total coating on both sides) both for site fabricated and factory fabricated ducts.

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

Larger Dimension of duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)

up to 750 mm	0.63 (24 G)	0.80
751 to 1500	0.80 (22 G)	1.00
1501 to 2250	1.00 (20 G)	1.50
2251 & above	1.25 (18 G)	1.80

4.04.03 **Duct Fabrication and Supports:**

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

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

c) The ducts routed inside the buildings with larger side greater than 2250 mm shall be supported by 16mm MS rods and 50x50x3 mm MS double Angles while those below 2250 mm shall be supported by 10mm MS Rods and 40x40x3 MS angles. The duct supports shall be at a distance of not more than 2000 mm for A/C system. The MS rods for these ducts routed inside the building shall be hung from the existing floor beams/wall beams/roof beams/columns with provision of necessary auxiliary or special steel members or by hooks or can be provided by dash fasteners fixed to the ceiling slab. No supports shall be taken from horizontal/vertical bracings of the structures. All items of duct support including MS rods, MS angles and double angles, auxiliary or special steel members, hooks, dash fasteners coach screws and all other supporting material required shall be provided by the bidder. Where ever ducts are running outside the building and or at locations where it is not possible to support the ducts from ceiling/floor due to non-availability of the same, the base steel frame/truss work and other auxiliary steel members, hooks, rods, etc. for supporting the duct work shall also be provided by the Bidder.

d) Where the sheet metal duct connects to the intake or discharge of fan units a flexible connection of fire retarding, at least 150 mm width shall be provided of closely woven, rubber impregnated double layer asbestos/canvas or neoprene coated fibre glass.

e) All curves, bends, off-sets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have the same velocity as in the main duct to which the branch duct is connected.

f) Wherever duct passes through a wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to the adjoining space.

g) Wherever pipe hangers or rods pass through the ducts, light and streamline easement around the same shall be provided to maintain smooth flow of air.

h) Access doors shall be provided in the duct work or casing on the both sides of the equipment to be serviced. All access doors shall be of adequate size and shall be lined with substantial felt edging to prevent air leakage. Access

doors shall be of built up construction, structurally strong and each shall have at least two hinges. Access doors shall have two rust proof window sash of approved type. All doors shall be set so as to flush with insulation or plaster finish on the duct.

4.04.04 Splitters and dampers shall be provided for equipment/area isolation and for proportional volume control of system. The same shall be minimum 16 gauge GS sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position.

4.04.05 **Factory fabricated ducts:**

i) All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I.

ii) Factory fabricated ducts shall have the thickness of the sheet as follows:

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

iii) Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards-Metal and Flexible-Second Edition-1995" SMACNA)

4.05.00 Diffusers, Grills & Dampers :

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

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

4.05.03 The diffusers/grills shall be of extruded Aluminum of minimum 2 mm thick with powder coating. The colour of power coating shall be as per the interior décor.

4.05.04 Supply air grills shall be of double deflection type and return air grills shall be of single deflection type.

4.05.05 All volume control (VC) damper shall be operated by a key from the front of the grills/diffusers and shall be of GI sheet.

4.05.06 The thickness of VC dampers shall be of minimum 20 gauge and thickness of louvers shall be of minimum 22 gauge.

4.05.07 Suitable vanes shall be provided in the duct collar to have uniform and proper air distribution. Bank of Baffles wherever required shall also be provided.

4.05.08 Fire dampers shall be motor operated type and shall have fire rating of minimum 90 minutes.

4.05.09 All plenum chambers of connections to fans, dampers etc shall be constructed in 18 gauge GS sheet and supported on MS angle frames.

4.05.10 All ducting surfaces coming in contact with corrosive fumes or gases shall be painted with three coats of epoxy paint over a coat of suitable primer.

4.05.11 Thermal and Acoustic Insulation.

4.06.00 **A) Application with Mineral Wool**

(a.) All surfaces to be insulated both thermally and acoustically shall be thoroughly cleaned, dried and an adhesive (CPRX compound of Shalimar Tar Products or Equivalent) be applied @ 1.5 Kg /Sqm on the surface.

(b.) Insulation material (either expanded polystyrene foam or Glass Wool/ Glass fiber or Equivalent) shall be struck to the surface. All the joints shall be sealed with bitumen.

(c.) Insulation mass to be covered with 500 gauge polythene sheet with 50 mm overlaps and sealing all joints on hot side.

(d.) Insulation Finish of types specified under shall be provided thereafter.

B) Application with Nitrile Rubber:

(a) All surfaces to be insulated shall be properly cleaned.

(b) A suitable adhesive such as SR 998 or equivalent shall be applied over the surfaces to be insulated and insulation material surfaces.

(c) Insulating material shall than be pasted onto the surfaces in a manner to avoid stretching and any air entrapment within.

(d) Two layers of Glass Cloth with a suitable adhesive as SR 998 or equivalent shall be then applied over the insulating material to avoid surface weathering.

C) Application with FR Closed Cell Chemically Cross Linked Polyethylene Material (XLPE)

(a) All surfaces to be insulated shall be properly cleaned of any dust, grease and moisture.

(b) A suitable adhesive, normally, a pressure sensitive acrylic base, such as SR 998/STAR Glue R242 or Neosole AA 900 or equivalent shall be used to paste the insulating material over the cleaned surface.

(c) XLPE cut to size for each surface, with overlaps provided for two faces shall be stuck to the surfaces in a manner to avoid air entrapment. The extent of over-lap

shall be equivalent to the thickness of the material to be applied. The adhesive is applied on both the surfaces to be insulated and the insulation foam material.

(d) Application of the insulating material to surfaces should preferably be carried out at ground level, in a clean dust free area.

(e) All joints- lateral & longitudinal, shall be taped with self adhesive aluminium foil tape 75 mm wide. The insulation over the surface shall be then held in position with 12mm wide PVC straps at every 600mm, to provide a neat & clean finish.

4.06.01 **Type of Insulation & Finish**

Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
1.	Supply & return air duct of A/C System	Resin bonded glass wool / Rockwool	Roll /Slab	50	F-3
		or			
		Closed Cell Elastomeric Nitrile Rubber	sheet	19	As per manufacturer std.
		Or			
		FR Closed Cell Chemically Cross Linked Polyethylene (XLPE) with Al foil face	Roll	19	F-3(a)
2.	Refrigerant (Suction and liquid lines)	Closed Cell Elastomeric Nitrile Rubber	Tube	19	As per manufacturer std.
		Or			
		FR Closed Cell Chemically Cross Linked Polyethylene (XLPE)	Pre-formed tube/roll	19	F-1(a)
3.	AHU drain pipe	Closed Cell Elastomeric Nitrile Rubber	Tube	19	As per manufacturer std.
		Or			
		FR Closed Cell	Pre-	19	F-1(a)

Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
		Chemically Cross Linked Polyethylene pre formed tubing (XLPE)	formed tube		
4.	AHU condensate pan (insulation if required)	Resin Bonded glass wool / rock wool Or FR Closed Cell Chemically Cross Linked Polyethylene (XLPE) with Al foil face	Slab Sheet	25 15	As per manufacturer std. F-1(a)
5.	Acoustic insulation of duct	Resin bonded Glass wool	Slab	25	As per specifications
6	Exposed air duct	Resin bonded glass wool / rock wool Or FR Closed Cell Chemically Cross Linked Polyethylene (XLPE) with Al foil face	Roll Roll	50 19	F-4 F-4(a)

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

Insulation Material	Code	Thermal conductivity (w/m/^{O}C)	Density Kg/m^3
Resin bonded glass wool / rock wool	IS:8183	0.049 at 50^{O}C	i) 24 (For thermal insulation) ii) 48(For acoustic insulation)

Mineral wool pipe section. Min.Gr.2	IS:9842	0.043 at 50°C	Rockwool – 144 Glasswool - 90
Closed Cell Elastomeric Nitrile Rubber		0.034 at 20°C	40-60
FR Closed Cell Chemically Cross Linked Polyethylene (XLPE)		0.033 at 23° C	33 ± 3

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

4.06.03 **The specification for various finishes shall be as follows**

a) **Finish F-1**

Step-1 Wrapping of Poly-Bonded Hessain (PBH – to act as vapour seal) on outer surface of insulation with 50 mm overlap stitching and sealing of overlap with synthetic adhesive like CPRX or Equivalent compound.

Step-2 The surface then shall be wrapped with 19 mm mesh 24 SWG GI wire netting, butting all the joints and laced down with 22 SWG lacing wire.

Step-3 Sand cement (4:1) plaster shall be applied in two layers totalling to 12.5 mm thick, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.

aa) **Finish F-1(a) (With FR Closed Cell Chemically Cross Linked Polyethylene Material)**

Wrapping of two layers of 7 mil 10x10 mesh glass cloth dipped in suitable adhesive such as SR 998 or equivalent.

b) **Finish F-2**

Step-1 Insulation shall be covered with 500g polythene with 50mm overlap and sealing of overlap with synthetic adhesive like CPRX or Equivalent compound.

Step-2 Same as Step-2 of Finish F-1 above.

Step-3 Same as Step-3 of Finish F-1 above.

c) **Finish F-3**

Step-1 Same as Step-1 of Finish F-2 above

Step-2 The polythene shall be covered with 30 gauge Aluminium sheet and locking of joints with self-locking screws at a pitch of minimum 100 mm.

cc)	**Finish F-3(a) (With FR Closed Cell Chemically Cross Linked Polyethylene Material)**
	Al foil faced XLPE material applied over duct surfaces, shall be covered with 30 gauge aluminium sheet, having tounge-in-groove joints and these are held in position with self drilling self tapping screws (SDST) at a distance of 150mm.
d)	**Finish F-4** Step-1 Same as Step-1 of Finish F-1 above. Step-2 Same as Step-2 of Finish F-1 above. Step-3 Same as Step-3 of Finish F-1 above. Step-4 Application of 3 mm thick coat of water proofing compound and wrapped with fibre glass RP tissue followed by final coat of 3 mm thick water proofing compound over the RP tissue. Step-5 After the above treatment, 22G Aluminium sheet cladding, properly stitched at all joints shall be provided over the external surface.
dd)	**Finish F-4(a) (With FR Closed Cell Chemically Cross Linked Polyethylene Material)**
	Application of aluminium sheet 22G cladding to be provided over the XLPE insulating material. Cladding sheet is held in position with SDST screws @ 150 mm C/C over tounge-in-groove joints applied with a felt for sealing joint against water ingress. Al sheet joints to be done in a manner to shed water.

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

4.07.00 **ACOUSTIC INSULATION**

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

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

4.08.00 FRESH AIR FANS (Axial Fans)

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

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

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

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

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

4.09.00 PLANT CONTROL

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

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

i. Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from employer.

ii. The basic function of the system shall be to closely control and monitor temperature and humidity conditions inside the air-conditioned spaces, to optimize / minimize energy consumption by automated operation, to provide remote centralized monitoring & control for various mechanical facilities including sequential start/stop of the whole Air conditioning System.

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

4.09.03 **Air Handling Unit**

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

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

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

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

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

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

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

4.09.05 **Miscellaneous Control Requirements**

a) Separate emergency local stop push button shall be provided for each compressor, fans etc. of A/C system.

b) The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally.

c) All the annunciations related to failure of equipments, tripping of equipments, source of failure / reason due to which the equipment is stopped / tripped, low & high limits of parameters such as level, temperature, pressure drop, pressure etc shall be provided for each pump, fan, compressor, AHU, air cooled condensing unit, etc.

d) Relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall made be available in ESP control system

4.10.00 **PAINTING:**

4.10.01 All the Equipments shall be protected against external corrosion by providing suitable painting.

4.10.02 The surfaces of stainless steel, Galvanized steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The Contractor shall clean the external surfaces and internal surfaces before Erection by wire brushing and air blowing. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting, etc. as per the agreed procedure.

4.10.03 For all the steel surfaces (external) exposed to atmosphere (outdoor installation), one(1) coat of red oxide primer of thickness 30 to 35 microns followed up with three

	(3) coats of synthetic enamel paint, with 25 microns as thickness of each coat, shall be applied.
4.10.04	For all the steel surfaces inside the building (indoor installation), One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat shall be applied
4.10.05	For centrifugal fans - Casing shall have hot dip/ spray galvanization (**minimum** 60 micron DFT).
4.10.06	However, for all parts coming in contact with acid fumes (in Battery rooms), a coat of epoxy resin based zinc phosphate primer of minimum thickness 30 to 35 microns followed up with undercoat of epoxy resin based paint pigmented with Titanium dioxide of minimum thickness of 25 microns shall be applied and a top coat consisting of one coat of epoxy paint of approved shade and colour with glossy finish of minimum thickness of 25 microns.
4.11.00	**CODES & STANDARDS**
4.11.01	The design, manufacture and performance of equipment shall comply with all currently applicable statues, regulations and safety codes in the locality where the equipments are to be installed. Nothing in this specification shall be considered to relieve the bidder of this responsibility.
4.11.02	Unless otherwise specified, equipment shall conform to the latest applicable Indian or IEC standard. Equipment complying with other authoritative standards such as British, USA, ASHRAE etc. will also be considered if it ensures performance equivalent or superior to Indian Standard.

SECTION: I

SUB-SECTION: C-3

TECHNICAL SPECIFICATION (C&I PORTION)

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SPECIFICATION FOR MEASURING INSTRUMENTS & LOCAL CONTROL PANEL

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

1.00.00 MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

1.01.00 Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, and makes/numbers as approved by the Employer during detailed engineering.

1.02.00 Every panel-mounted instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus. Screwed type terminals can also be used for signal connection instead of plug in socket type terminals for instruments & solenoids mounted in the equipment skids or panels if it is the standard and proven design of equipment manufacturer.

1.03.00 All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment under the scope of specification shall be provided on as required basis within the quoted lump sum price.

contractor shall supply any additional local gauges /switches /transmitters / sensors for reasons mentioned above without any additional cost to the Employer.

1.04.00 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of

these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.

1.05.00 All instruments envisaged for sea water application shall be provided with wetted parts made of Monel/ Hastelloy C or any other better material (if proven ness experience of the proposed material for such applications is established by contractor)

1.06.00 For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.

2.00.00 SPECIFICATION FOR TRANSMITTERS

2.01.00 Specification for Electronic Transmitters for Press, Diff Press, DP based Flow, Level measurement.

Sr.No	Features		Essential/Minimum Requirements
1.	Type of Transmitter	:	Microprocessor based 2 wire type (loop powered), HART protocol compatible.
2.	Accuracy	:	± 0.1% of calibrated span (minimum)
3.	Output signal	:	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)
4.	Turn down ratio (minimum)	:	10:1 for vacuum/very low pressure applications. (i.e. pressure <= 200mmWC). 5:1 for very high pressure applications (i.e. pressure >= 200 Kg/cm2). 30:1 for other applications.

5.	Stability	:	± 0.1% of calibrated span for six months for Ranges up to and including 70 Kg/cm² (g). ± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm² (g).
6.	Zero and span drift	:	+/- 0.015% per deg.C at max span. +/-0.11% per deg.C at min. span.
7.	Load impedance	:	500 ohm (min.)
8.	Housing	:	Weather proof as per IP-65, metallic housing with durable corrosion resistant coating.
9.	Over Pressure	:	150% of max. Operating pressure.
10.	Electrical connection	:	Plug and socket type.
11.	Process connection	:	1/2 inch NPT (F)
12.	Span and Zero adjustment	:	Continuous, tamper proof, Remote as well as manual adjustability from instrument with zero suppression and elevation facility.
13.	Accessories	:	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & Gauge pressure transmitters, 3-valve manifold for vacuum pressure transmitters & where DP transmitters are being used for pressure measurement and 5 valve manifolds for DP/Level/Flow application. -For hazardous area, explosions proof enclosure

			as described in NEC article 500.
14.	Diagnostics & Display	:	Self-Indicating feature and digital display on transmitter.
15.	Power supply	:	24V DC ± 10%.
16.	Adjustment/calibration/ maintenance	:	Using hand held HART calibrators

Notes

1) LVDT type is not acceptable.

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

2.03.00 **NOT USED**

2.04.00 **Specification for TEMP ELEMENTS**

2.04.01 **Specification for Resistance Temperature Detector (RTD)**

Sr. No.	Features		Essential/Minimum Requirements
1	Type of RTD.	:	Pt-100 (100 Ohms resistance at zero degree Centigrade), four wire.
2	No. of element	:	Duplex
3	Housing/Head	:	IP-65/ Diecast Aluminum. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connector for external signal cable connection shall be provided. Headless type of TE can be provided for special applications where equipment design limitations restrict the head type arrangement.
4	Insulation and sheathing of RTD	:	Mineral insulation (magnesium oxide) and SS316 sheath, ceramic packed.
5	Calibration and accuracy	:	As per IEC-751/ DIN-43760 Class-A for RTD
6	Characteristic	:	Linear with respect to temp, within ±1/2 of top range value
7	Accessories	:	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.

8	Standard	:	IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for thermo well.

NOTES :

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

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

4.00.00 **Specification for Press Gauge, DP Gauge, Temp Gauge, Level Gauge**

	FEATURES	ESSENTIAL/ MINIMUM REQUIREMENTS		
		Pr. Gauge/ DP Gauge/ Draught gauges	**Temperature Gauge**	**Level Gauge**
1	Sensing Element	Bourdon for high pressure measurement, Diaphragm/ Bellow for low press measurement.	Mercury in steel / inert gas actuated.	Tempered * toughened Borosilicate gauge glass , steel armoured reflex or transparent type.
2	Body material	Die-cast aluminum.	Die-cast aluminum.	Forged carbon steel/ 304 SS.
3	Dial size	150 mm.	150 mm	Tubular covering Process connection± 2%
4	End connection.	1/2 inch NPT (F) as per ASME PTC.	1/2 inch or 3/4 inch NPT (M).	Process connection as per ASME PTC and drain/vent 15 NB.
5	Accuracy	±1% of span	± 1% of span	± 2%
6	Scale	Linear, 270° arc graduated in metric units.	Linear, 270° arc graduated in °C.	Linear vertical
7	Range selection	Shall cover 125% of max operating press.	Shall cover 125% of max operating temp.	Shall cover max process level.

8	Over range test	125% of FSD.	125% of FSD.	
9	Housing	Weather and dust proof as per IP-55.	Weather and dust proof as per IP-55.	CS/ 304 SS leak proof.
10	Zero/span adjustment	Provided	Provided	—
11	Identification	Suitable metal service tag shall be provided.		
12	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal(if required by process) gauge isolation valve.	SS Thermo well	Gasket for all KEL-F shields for transparent type. Vent and drain valves of Steel/ SS as per CS/ Alloy process Requirement. For acid / alkali applications material of drain and vent valves shall be as suitable for these mediums.
13	Material of sensor/ movement	316 SS / 304 SS	316 SS / 304 SS	

Notes:-

1) *Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

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

3) Pressure/ Diff pressure gauges for very low press/ DP measurements can have sensor material other than SS316 e.g. silicon etc., if the offered material is suitable for that application and the offered product is standard product of the manufacture for very low pressure applications.

4) The specifications for gauges which are integral part of motor bearings can be as per their manufacturer standards.

6.00.00 PROCESS ACTUATED SWITCHES

FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
	Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low press/ vacuum	Vapor pressure sensing type, Liquid filled bellow type with SS bulb and capillary (5 mtr minimum)	Capacitance types, Float type, Conductivity type, RF type, Ultrasonic type as per suitability to the application.
Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
Over range proof pressure	150% of Design press.	-	150% of design press.
Repeatability	+/-0.5% of full range	+/-0.5% of full range.	+/-0.5% of full range.
No. of contacts	2 No+2NC SPDT snap action dry contact		
Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS or PLC)		
Elect. Connection	Plug in socket		

Set point adjustment	Provided over full range.		
Dead band/ differential	Adjustable/ fixed as per requirement of application.		
Enclosure	Weather and dust proof as per IP-55 , metallic housing.		
Accessories	Syphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and other required accessories.	All mounting accessories
Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-

Notes :

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

2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 e.g. silicon etc., if the offered material is suitable for that application and the offered product is standard product of the manufacture for very low pressure applications.

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

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

10.00.00	**CONTROL CABINETS / PANELS / DESKS**
10.01.00	The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.
10.01.01	The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.

CLAUSE NO.	TECHNICAL REQUIREMENTS
10.01.02	The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.
10.01.03	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.
10.01.04	Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The finish colors for exterior and interior surfaces shall conform to following shades: (a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalised during detailed engineering. (b.) Interior:- Same as above.
10.01.05	Paint films which show sags, checks or other imperfections shall not be acceptable.
10.01.05	As an alternative, single coat of anodic dipcoat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.
10.01.06	Refer Subsection Basic Design Criteria, Part-B, Section-VI for grounding requirements.
10.02.00	The mimic shall be configured on the OWS/CRTs and it shall be possible to control, monitor and operate the plant from the same.
10.03.00	The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section INST CABLE of this specification.

1.0 SCOPE

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

2.0 CODES AND STANDARDS

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

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

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

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

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

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

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

3.1.4 The salient features of construction shall be:

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

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

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

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

3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified

3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type shall be supplied alongwith the Panel.

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

3.1.11 Single / dual control power supply feeders of voltage class shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

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

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

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

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

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

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

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

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

3.2 Hazardous Area Panel Requirement

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

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

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

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

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

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

3.3 Control & Monitoring devices

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

3.3.2 Alarm Annunciator System

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

3.3.3 Relays

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

3.3.4 Timers

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

3.3.5 Control / Selector Switches

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

3.3.6 Push Buttons / Indicating Lights

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

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

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

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

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type
Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)

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

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

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

4.0 TESTING AND INSPECTION

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

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

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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

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

5.2. Mandatory Spares

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

5.3. Recommended Spares

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

6.0 DRAWINGS AND DOCUMENTS

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

1. Data Sheet
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

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

1. Data Shee
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

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

	TECHNICAL SPECIFICATION (C&I) FOR AC & VENTILATION PKG	

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LIST OF DOCUMENTS/DELIVERABLES

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR
RAMAGUNDAM STPS STAGE-I(3X200MW)
R&M of ESP

Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1PE-	V0-480-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2PE-	V0-480-145-I902	CONTROL SCHEME/LOGIC DIAGRAM	A
4PE-	V0-480-145-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5PE-	V0-480-145-I905	I/O LIST (ANALOG & BINARY)	A
6PE-	V0-480-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA (if applicable)	A
7PE-	V0-480-145-I907	FIELD JB/LIE/LIR, DRIVES TERMINATIONS	A
8PE-	V0-480-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9PE-	V0-480-145-I909	QUALITY PLANS (INSTRUMENTS,LCP etc.)	A

NOTES:1.ANYOTHERDOCUMENTDECIDEDDURINGDETAILEDENGINEERINGSHALLBEPROVIDEDBYBIDDERWITHOUTANY COMMERCIAL/TECHNICAL IMPLICATION.
2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.

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CONTROL & INTERLOCK

4.09.00 PLANT CONTROL

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

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

i. Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from employer.

ii. The basic function of the system shall be to closely control and monitor temperature and humidity conditions inside the air-conditioned spaces, to optimize / minimize energy consumption by automated operation, to provide remote centralized monitoring & control for various mechanical facilities including sequential start/stop of the whole Air conditioning System.

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

4.09.03 **Air Handling Unit**

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

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

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

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

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

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

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

4.09.05 **Miscellaneous Control Requirements**

a) Separate emergency local stop push button shall be provided for each compressor, fans etc. of A/C system.

b) The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally.

c) All the annunciations related to failure of equipment, tripping of equipment,

source of failure / reason due to which the equipment is stopped / tripped, low & high limits of parameters such as level, temperature, pressure drop, pressure etc. shall be provided for each pump, fan, compressor, AHU, air cooled condensing unit, etc.

d) Relative humidity and temperature measurement of all control rooms and all major air-conditioned areas shall made be available in ESP control system

1.00.00 **GENERAL**

1.01.00 Complete air conditioning system and equipment shall be designed as per the Design Philosophy & Equipment specification elaborated below. Sizing calculations for all the equipment shall be submitted for approval of owner during the design phase.

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

2.00.00 **DESIGN PHILOSOPHY**

1. Design ambient conditions for all air conditioning system shall be as indicated below:

Season	Dry Bulb Temp. (Deg. C)	Wet Bulb Temp. (Deg. C)
Summer	**43.0**	**27.5**
Monsoon	**38.0**	**29.5**
Winter	**7.0**	**5.8**

2. All equipment of Air Conditioning system shall be designed for continuous duty.
3. Air conditioned areas shall be maintained at 24 deg. C ± (plus or minus) 1 deg. C and relative humidity of 50% ± (plus or minus) 5%.
4. The fresh air quantity fresh air shall be minimum 1.5 air changes per hour. Fresh air fan capacity shall be minimum 10% of the total CMH value of working indoor units.
5. Lighting load shall be 2 Watts/Sq. feet.
6. The occupancy shall be minimum one person per 25 Sq.M (Minimum).
7. In Air conditioning system the return air shall be through ducts and use of plenum space for return air shall be avoided.
8. The supply and return air ducts shall be provided with automatic (motorized) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls & floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts in control panel of A/C plant and further wiring upto fire alarm panels shall be done by Bidder. Closure of fire dampers shall raise an alarm in the system.
9. Coil face area of Air Handling units shall be designed considering a face velocity of not more than 2.5 m/sec. Air distribution system shall be sized to have a

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QUALITY ASSURANCE FOR INSTRUMENTS & LOCAL CONTROL PANEL

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable)(R)	Hydro Test(R)	Material Test certificate ®
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
3. Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter(IEC-770)	Y	Y	Y	Y	Y	Y			
5. Temp. Switch	Y	Y	Y	Y	Y	Y			
6. Recorder(IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Y		Y			
9. Integrators	Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples (IEC – 754 / ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD(IEC-751)	Y	Y	Y	Y	Y	Y			
14. Thermowell	Y		Y				Y	Y	Y

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

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

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 1 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
	RAW MATERIAL													
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		2. Bend Test	CR	Mech. test	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		3. Surface finish	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Waviness	MA	Visual	100%	10%	Manufacturing Standard	No Waviness	Inspection Report	√	P/W	---		
		5. Thickness	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		6. Mill marking	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Sample	IS:2062	IS:2062	Test Certificate	√	P/W	---		
		2. Surface Defects	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		3. Straightness	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Mill marking	MA	Visual	100%	10%	IS:2062	IS:2062	Inspection Report	√	P/W	V		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/10/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

बी एच ई एल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
		PROJECT:		PO NO.: --	DATE: --
		ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 2 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6 M	6 C/N	7	8	9	D	** M	C	N	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		2. IR and HV	MA	Electrical	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	 10% 10% 10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		4. Type / Routine Test Certificates	MA	Verification	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays	1. Verification at make and Type	CR	Visual	Sample	Sample	Approved Drg/Datasheet	Approved Drg/Datasheet	Test Certificate	√	P/W			
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		3. Operation / Functional check	CR	Electrical	Sample+ 100% @	Sample+ 10% @	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			+ for relay & contactors only

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 3 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**		
					M	C/N				D	M	C	N	
	Timers, Space Heaters, Thermostat, Indicating meters etc.	4. I.R.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		6. Calibration	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W	V		
		7. Pick up / Drop off Voltage	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		2. Surface defects	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
	IN PROCESS INSPECTION													

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 4 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Surface defects after bending	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W			
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Deburring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
	ASSEMBLY													
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Alignment	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Welding Quality	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Surface defects	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/5/2020	CHETAN MALIK	Checked by:	14/05/2020	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/5/2020	RK RAINA	Reviewed by:	14/5/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 5 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**		
					M	C/N				D	M	C	N
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Periodic	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V	
		3. Dipping / Removal Time	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V	
		4. Surface quality after every dip	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V	
		5. Primer after phosphating	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V	
		7. Paint first coat	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/2/2020	KUNDAN PRASAD
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-1056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 6 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**		
					M	C/N				D	M	C	N	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Ferrule numbers	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Colour of wiring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		5. Size of Conductor	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
11.	Component Mounting	1. Correct components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Fixing	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 7 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
	FINAL TESTING													
12.	Final Inspection	1. Workmanship	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		3. Components identification Marking / Name plates	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		5. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		6. Door functioning	MA	Functional	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		7. Paint Shade	CR	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 8 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
		8. Paint Thickness	CR	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		9. Workmanship of Gaskets	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		10. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		11. Wire Termination	MA	Pulling manually	Sample	Sample	-----	Firm termination	Inspection Report	√	P/W	W		
		12. Continuity	MA	Electrical	100%	10%	-----	Continuity OK	Inspection Report	√	P/W	W		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	Sample	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	√	P/W	V		
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 9 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		2. Instrument Calibration	CR	Electrical	10%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		3. Temperature rise	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

NOTES:

1. Customer's specification for painting shall be included in the technical specification. In the absence of Customer's spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
2. Copies of all TC's (Test Certificates) for components shall be submitted to BHEL for verification and acceptance.
3. BHEL reserves the right to conduct repeat tests, if required.

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

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

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MOTORISED VALVE ACTUATOR

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.00.00	**CODES AND STANDARDS:**
1.01.00	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of conflict between this specification and codes, standards, etc, the former shall prevail.
2.00.00	**ELECTRIC ACTUATORS WITH INTEGRAL STARTERS**
2.01.00	**TYPE:**
2.01.01	The actuators shall have integral starters along with over load relays with built in SPP (Single Phasing Preventer). Alternatively Smart non-intrusive actuators are also acceptable. A 415, 3 phase 3 wire power supply shall be given to the actuator from vendor's/employer's switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply.
2.01.02	In case supplier's standard control voltage for Open/Close contactors is 110V AC, the same is acceptable if suitable Opto Isolation circuit is provided with coupling relays for 24 V DC command inputs.
2.02.00	**INTERFACES:**
2.02.01	Open/Close command termination logic with position & torque Limit Switches, positioner circuit shall be suitably built in the PCB inside the actuator. (a) For Binary Drive (both ON-OFF and INCHING type) :- Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided. Interface with the control system shall be through hardware signal only. Inter posing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system. (b) For Modulating Drive:- The command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided. Also these actuators shall be Continuous modulating type. (c) Open/close command termination logic shall be suitably built inside actuator.
2.03.00	**RATING:** (a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%. (b) Sizing:- Open/Close at rated speed against designed differential pressure at 90% of rated voltage.

For isolating service:- Three successive open-close operations or 15 mins, whichever is higher. For regulating service 3000 starts per hour or required cycles, whichever is higher.

2.04.00 CONSTRUCTION:

(a) Enclosure:

Totally enclosed weatherproof minimum IP-55 degree of protection.

(b) Gear Train :

Metal (Fibre gears are not acceptable)) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energized.

(c) Manual Wheel:

Shall disengage automatically during motor operation.

2.05.00 MOTOR :

(a) Type :

Squirrel cage induction motor suitable for Direct On Line (DOL)starting.

(b) Enclosure:

Totally enclosed, self ventilated IP-55 degree of protection.

(c) Insulation

Class B or better. Temperature rise 70 Deg C. over 50 Deg C ambient

(d) Bearings:

Double shielded, grease lubricated antifriction.

(e) Earth Terminals:

Two

(f) Protection:

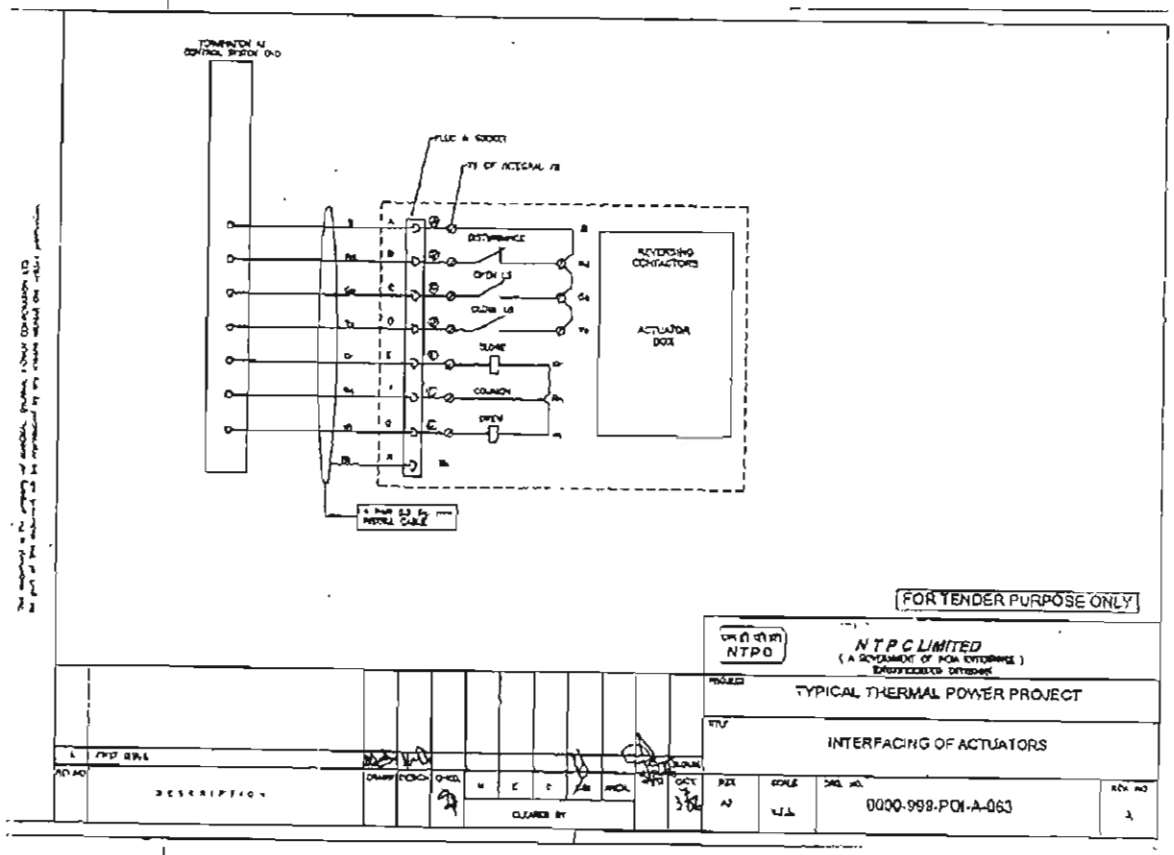
Single Phasing Protection, Over heating protection through Thermostat (as applicable) and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design Suitable means shall be provided to diagnose the type of fault locally.

2.06.00 POSITION/TORQUE SWITCHES:

2.06.01 Four nos. (2 each in open and close position) position limit switches/contacts and

	two nos. (one in open and other in close direction) torque switches/contacts each having two nos. NO and two nos. NC contacts shall be provided. Torque switches/contacts shall be bypassed in both the end positions with the other end Limit switches/contacts. **Limit switches**/contacts Limit switches shall be Silver plated with high conductivity and non –corrosive type. Contact rating shall be sufficient to meet the requirement of Control System subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP-55. Limit switch/contacts and disturbance signals shall be available to DCS even when the power supply to the actuators is not available.
2.07.00	**LOCAL OPERATION:**
2.07.01	It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.
2.08.00	**POSITION INDICATOR :**
2.08.01	To be provided for 0 to 100% travel.
2.09.00	**POSITION TRANSMITTER (FOR MODULATING/INCHING TYPE) :**
2.09.01	As required. Suitable for stabilized 4-20 mA signal, 2 wire inductive type, External 24 volts DC operated.
2.10.00	**WIRING :**
2.10.01	Suitable voltage grade copper wire.
2.11.00	**TERMINAL BOX :** (i) 9 pin plug and socket (1 no. per actuator to suit 4 pair 0.5 sq.mm. copper overall shielded (16 mm OD), instrumentation cable) suitably mounted in the starter box itself to terminate open/close command and status feedback signals with external control systems. (ii) Additional one number 9 pin plug and socket (to suit 4 pair 0.5 sq.mm copper (16 mm OD) individual and overall shielded instrumentation cable) suitably mounted in the starter box itself for actuators with 4-20 mA position transmitters. (iii) Necessary glands for power cables shall be provided.

2.12.00	**TERMINAL BLOCK :**
2.12.01	650V grade. For power cables.
2.13.00	**SPACE HEATER :**
2.13.01	Space heater of suitable rating. The supply shall be derived from the main power supply available in the actuator.
2.14.00	**TYPICAL WIRING DIAGRAM :**
2.14.01	Refer Tender Drawing No. 0000-999-POI-A-063.



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MANDATORY SPARES

Item	Description			Code**	Qty.	UNIT PRICE@ Ex-Works (including Entry Tax)	TOTAL PRICE@ Ex-Works (including Entry Tax)
1	E.. ELECTRICAL ACTUATOR			3	4	5	6
		1	Actuators		4 no. of each type, class, size and model whichever is more.		
	F.	PLC					
		i)	PLC cards (Processor, memory and all cards other than I/O cards)		1 No. of each type.		
		ii)	I/O Cards		2 Nos. of each type and rating.		
		iii)	Fuses & Fused terminals		10 Nos. of each type and rating		
		iv)	Set of cards for UPS		1 set		
	G.	CONTROL PANELS					
		i)	Control supply transformer (if any)		1 no. of each type and rating		
		ii)	Relays and timers		1 no. of each type and rating		
		iii)	Contactors		1 no. of each type and rating		
		iv)	LEDs		5 nos. of each type and rating		
		v)	Control switches		1 no. of each type		
		vi)	Selector switches		1 no. of each type		
		vii)	Push buttons (complete with contact elements)		2 nos. of each type and colour		
		viii)	Any special meters		1 no. of each type		

Item	Description	Code**	Qty.	UNIT PRICE@ Ex-Works (including Entry Tax)	TOTAL PRICE@ Ex-Works (including Entry Tax)
1	2	3	4	5	6
	H. Power and Control Cables/Cabling System (if applicable)				
	i) Terminating kits with all accessories and consumables for each rating and type of cable used.		2 nos.		
	ii) Jointing kits (if applicable) with all accessories and consumables for each rating and type of cable used.		2 nos.		
9.00.00	**CONTROL & INSTRUMENTATION**				
	A. MEASURING INSTRUMENTS				
	1) Transmitters of all types and model no. (for the measurement of Pressure, differential pressure, level etc.).		10% or 1 no of each type and model whichever is more.		
	2) Temperature elements along with thermo well (except winding temp elements of motor).		10% or 1 no. of each type and model which ever is more.		
	3) Local gauges for Press, Diff press, Temp		1 no. of each range and type		
	4) Process Actuated Switch Devices				
	i) Includes all types of Pressure, differential pressure, flow, temperature, level switch Devices.		10% or 1 no. of each type and model whichever is more		
	ii) Limit switches (for Pneumatic and manual valves)		10% or 2 no. of each type, rating which ever is more		
	B PROCESS CONNECTION PIPING				
	2 way, 3way, 5way valve manifolds		10% or 1 no. of each type, class, size and model whichever is more.		
	SUB - TOTAL (II) MANDATORY SPARES				
	SUB - TOTAL (III) TYPE TEST CHARGES (AS PER FROM SCHEDULE - 8B)				

SECTION I
SUB SECTION D

STANDARD TECHNICAL SPECIFICATION FOR PACKAGE CONDITIONING UNIT

1 GENERAL

1.1 This specification covers the design, manufacture, inspection and testing at the manufacturer's works and suitable packing delivery and testing of the packaged air conditioning unit.

2 CODES AND STANDARDS

2.1 The design, manufacture, inspection, testing and performance of the packaged type air conditioning unit shall comply with all statutes, regulations and safety codes currently applicable in the locality where the equipment will be installed. The equipment shall also conform to the latest editions of the codes and standards specified herein under. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

In particular, the packaged air conditioning Unit (max 7.5 TR capacity, ductable or non ductable type) or cassette type (up to 5 TR) shall conform to the latest editions of the following standards:

2.1.1 I.S.660 : Safety code for Mechanical Refrigeration.

2.1.2 I.S.5111 : Code of practice for measurement, and testing of refrigerant compressor.

2.1.3 I.S.659 : Safety code for air conditioning.

2.1.4 I.S.2494 : V Belt for industrial purpose.

2.1.5 I.S.3142 : V grooved pullies for V Belts.

2.1.6 I.S.4503 : Shell and tube type heat exchanger.

2.1.7 ARI 210 : Standard for/unitary air conditioning equipment

2.1.8 ARI 270 : Standard for application installation and servicing of unitary equipment.

2.1.9 ASHRAE-37 : Standard methods of testing for rating unitary air conditioning and heat pump / equipment.

2.1.10 ANSI-B9-1 : Safety code for mechanical refrigeration.

3 DESIGN AND CONSTRUCTIONAL REQUIREMENTS

3.1 Compressor

The compressor shall be hermatic or semi-hermatic or screw rotary type or scroll type. The same shall be suitable for R410A/R407C/R134A refrigerant. The compressor shall be mounted on anti-vibration spring/rubber pads and shall be positioned in such a way that it is freely accessable with sufficient space all around for easy maintenance. Safety controls like High and Low pressure cut-out overload and single phasing protection for the motors shall be provided. A crankcase heater shall also be provided, if considered necessary by the vendor.

3.2 **CONDENSING UNIT**

Shell and tube type water cooled condenser or air cooled condenser with adequate area shall be provided as specified in Data Sheet-A. The condensing unit shall be complete with

multipass heads and shall be fitted with the following:

3.2.1 Hot gas inlet and liquid outlet connection with shut off valve for liquid.

3.2.2 Drain plug, air vent and test valve.

3.2.3 Water inlet and outlet connection with thermowell and suitable cocks respectively.

3.2.4 Relief valve and air purge valve (Fusible plug in place of relief valve not acceptable)

3.2.5 Any other accessory as recommended by the manufacturer for proper functioning of the equipment.

3.3 AIR HANDLING FAN

The air handling fan shall be of the centrifugal type and with forward curved blades. This shall be driven by means of a three phase induction motor through V belt drive. The fan static pressure shall be selected for passing air through high efficiency absolute filters, if specified in Data Sheet-A.

3.4 FILTERS

Filters shall be of dry panel type and shall be cleanable. The velocity of air across the filters shall not exceed 1.75m/sec (350FPM).

3.5 COOLING COIL

The cooling coil shall be of direct expansion type and shall be made of heavy gauge copper with aluminium fins. The fins shall be bonded to the copper tubes under hydraulic pressure. A distributor shall be provided for feeding the refrigerant to different sections of the coil. Rows shall be staggered in the directions of airflow. The velocity of air across coil shall not exceed 2.5M/Sec. (500 FPM).

3.6 CONTROLS

All necessary controls and accessories like thermostatic expansion valve, refrigerant solenoid valve, distributor, filter drier in the liquid lines, shut off valves, HP/LP cut out for compressor, thermostat with adjustable settings, overload and single phasing preventer for motor etc. are to be provided. The microprocessor based control panel shall be provided outside the packaged unit on one side. The control panel shall generally be in line with the specification for control panels given elsewhere.

The control shall be so interlocked that the fan shall be started independently first, and then only the compressor. Tripping of the compressor by the thermostat or compressor cut outs shall not trip the fan. The thermostat setting shall be adjustable

3.7 REFRIGERANT PIPING

The refrigerant piping shall be either heavy gauge copper as furnished in Data Sheet-A. The piping shall be completely factory assembled, pressure tested, dehydrated and initially charged with FREON gas and compressor oil. The line accessories shall include liquid line shutoff valve dehydrator, strainer, flow indicator and distributor etc.

3.8 CABINET

All the equipments, except control panel, mentioned above shall be provided within a heavy gauge sheet metal cabinet, of floor/ wall mounted type. This shall be given two coats of anti-corrosive and rust proof paint, finished with two coats of final paint . Painting shall be as per manufacturers std unless specified otherwise in data sheet 'A'. The interior of the cabinet shall be provided with thermal and acoustic insulation of minimum 25mm thick. The insulating material shall be fire proof.

The front and back side of the cabinets shall be easily removable providing maintenance to all the interior parts.

All the electric wires within the cabinet shall run in flexible conduits and carry identification tags. The bottom side of the panel shall be specially ribbed to take care of the transportation.

3.9 **OTHER ACCESSORIES**

Each packaged air conditioner shall be provided with required number of neoprene rubber isolating pads.

4 CONTROL AND INTERLOCK REQUIREMENTS

The compressor shall have all protective devices like HP/LP cutouts, overload protection for the motor, single phasing preventor for motor etc.

The interlocking requirement shall be as indicated below:

4.1 The compressor shall not start, unless condenser water flow is achieved for water cooled condenser. The condenser flow shall be sensed by means of a flow switch.

4.2 The compressor shall not start unless the evaporator fan is started.

4.3 The tripping of compressor on HP/LP, overload or on thermostat shall not trip the fan.

4.4 Strip heater (if provided in the ducting system) shall not be switched on, unless the evaporator fan is started and airflow is established. For this purpose, an air stat on flow switch shall be used. The heater shall be separately controlled by humidistat/thermostat

4.5 A humidifying package, if specified in data sheet A, shall be controlled by humidistat.

5 TEST AND INPSECTION

5.1 Inspection and Testing at Manufacturer's Works

5.1.1 static and dynamic test for fans

5.1.2 Hydrostatic static test on condenser and cooling coil.

5.1.3 vacuum/pressure test for the complete refrigeration circuit.

5.1.4 Visual and Free running test of the packaged unit on test bed.

5.1.5 Free running test on compressor.

5.1.6 AIR CAPACITY WITH ANEMOMETER.

5.1.7 NOISE LEVEL- <=85 dB(A).

5.1.8 Other tests as per approved qualities plan/scope of inspection.

5.2 Inspection and Testing at Site

5.2.1 Performance testing of the packaged unit for 72 hours in summer / monsoon & 24 hours in winter. Up-to 3 TR (individual M/c capacity) inside room temperature (Dry & wet bulb) will be checked with all machines in the room operating.

The actual days of testing shall be mutually agreed. During the above testing, the following readings shall be taken to compare the same with guaranteed performance data.

5.2.1.1 Condenser inlet and outlet pressure and temperature

5.2.1.2 Entering and leaving air temperature of the cooling coil air filters.

5.2.1.3 Motor current for the compressor and blower.

5.2.1.4 Air quantity delivered by the fan. This shall be computed by adding air quantity leaving all the grilles entering the air filters.

Room temperature (Dry & wet bulb)

5.2.1.5 Test to ensure all controls and safety instruments are working properly.

During the above testing, noise level also will be checked to ensure that the same are within acceptable limits. Any undue vibration detected physically will be corrected.

All tools and instruments required for the above testing will be provided by the vendor.

6 PAINTING:

The packaged unit shall be given two coats of primer paint finished with two coats of finish paint as per Manufacturers std. unless specified otherwise elsewhere/ Data sheet 'A'. The colour of finish paint will be as specified in Data Sheet-A.

7 GUARANTEES

The package unit shall be guaranteed for performance measured in terms of the inside temperature maintained.

The packaged unit shall also be free from any manufacturing defects and shall be guaranteed as per contract after the first test as per 5.0 is successfully carried out, and the plant taken over by the purchaser.

8 NAME PLATES

Suitable Name plate as per Data Sheet 'A', depicting the equipment number as designated in Data Sheet A shall be provided for each packaged unit and screwed to a prominent position on the packaged unit.

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1 Final technical data as per Data Sheet-B

9.2 G.A. and interior view of packaged unit

9.3 Electrical wiring diagram

9.4 Catalogues for all controls

9.5 O & M Manual

9.6 Erection Manual

DESCRIPTION		DATA
1)	Capacity of the unit at operating conditions.	: As specified
2)	Numbers required	: Refer to Section-C of Specific Technical Requirements
3)	Designation of the unit	: Package AC Unit
4)	Whether air cooled/water cooled	: Refer to Section-C of Specific Technical Requirements
5)	The plant shall be suitable for maximum- - ambient temp.	: Refer outdoor design condition as specified.
6)	Whether a plenum Chamber required	: Units shall be connected to fresh air ducts.
	OR	
	Whether to be connected duct system.	: Yes.
7)	Whether Humidifier required for humidity- -control.	: Refer to Section-C of Specific Technical Requirements
8)	Whether strip heaters required for winter heating.	: Refer to Section-C of Specific Technical Requirements
9)	Whether strip heater required for Humidity control.	: Refer to Section-C of Specific Technical Requirements
10)	Final painting colour shade stage.	: Subject to approval / during detail engineering
11)	Whether fan static pressure is to be designed for filters arrangement shown.	: Yes.
12)	Installation supporting structure/ drain piping, insulation.	: Required. Drain piping with insulation up to the nearest drain point.
13)	Controls & Instruments	: Yes (Lot)
14)	Isolation Switch	: Yes

SECTION-I
SUB SECTION –E

ANNEXURE-I
LIST OF MAKES OF SUB-VENDOR ITEMS
(REFER REFERENCE DOCUMENTS)

SECTION-I
SUB SECTION -E

ANNEXURE-II

MANDATORY SPARES LIST
(Refer Price Schedule)

Break Up of Mandatory Spares for Electrical Equipment				
Sl. No.	**Description**	**Type**	**Make**	**Rating**
A	**HVAC System**			
1	**ELECTRICAL ACTUATORS**			
1.1	Actuators*			
1.2	Control/ Selector Switch	A/M Selector switch	KAYCEE	10A
1.3	Control MCB	SP (C curve)	L & T	6A
1.4	Neutral Link		Reputed	
1.5	Vertical Busbar dropper support insulator	10mm Drum Insulator, H- 50mm	Reputed	1100 Volt grade
1.6	Power Fuses	32A F50- Bolted Type	L & T	32 A
1.7	Each type of Contactor		L & T	
	18A, 1 NO	MNX18		18A, 230V AC Coil Voltage
	12A, 1 NO	MNX12		12A, 230V AC Coil Voltage
	9A, 1 NO	MNX9		9A, 230V AC Coil Voltage
1.8	Contractor Coil of each type and rating			
	18A, 1 NO	MNX18	L & T	18A, 230V AC Coil Voltage
	12A, 1 NO	MNX12		12A, 230V AC Coil Voltage
	9A, 1 NO	MNX9		9A, 230V AC Coil Voltage
1.9	Indication Lamp			
	RED	LED	L&T/ESBEE	230V AC, 22ø
	YELLOW	LED	L&T/ESBEE	230V AC, 22ø
	BLUE	LED	L&T/ESBEE	230V AC, 22ø
	GREEN	LED	L&T/ESBEE	230V AC, 22ø
	AMBER	LED	L&T/ESBEE	230V AC, 22ø
1.10	Each type of Push Button			
	Red Push Button + 1NC Element		ESBEE	230V AC
	Green Push Button + 1NO Element		ESBEE	230V AC
1.11	indicating Lampholders complete	Suitable for above lamps	Reputed	Suitable for above lamps
1.12	Terminal Blocks of each type and rating.	Suitable for 6Sq.mm. Wire	Elmex	1100V Grade
1.13	Horizontal Busbar Support Insulator	8mm Drum Insulator,H- 50mm	Reputed	1100 Volt Grade

*For Actuators - in case applicable for control system, same shall be provided by bidder.

SECTION-I SUB SECTION E

- **ANNEXURE-III - PAINTING & COLOUR SCHEME (REFER SECTION C2)**

- **ANNEXURE-IV - LIST OF TOOLS & TACKLES REFER SUGGESTIVE PRICE FORMAT**

- **ANNEXURE-V - MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION (COVERED UNDER SUB-SECTION C1)**

SECTION-I

SUB-SECTION-E

ANNEXURE-VI

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	**COVER PAGE**				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	**INDEX**				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	**DESCRIPTION OF PLANT/SYSTEM**				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
3.8	Control philosophy /control write-ups				
4.0	**COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)**				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	**OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR**				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	**MAINTENANCE GUIDELINES FOR PLANT**				

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
	PERSONAL				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

SECTION-I

SUB-SECTION-E

ANNEXURE-VII

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. ‘No smoking’ signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

    - Ingress of moisture and corrosion damages.
    - Damage to protective coating.
    - Open ends in pipes, vessels and equipment -
        - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

    - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
    - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere**. (C)

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.

ii **Semi-closed storage**. (S)

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.

iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.

The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	**Description of the equipment**	**Type of Storage**	**Check for**	**Remarks**
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

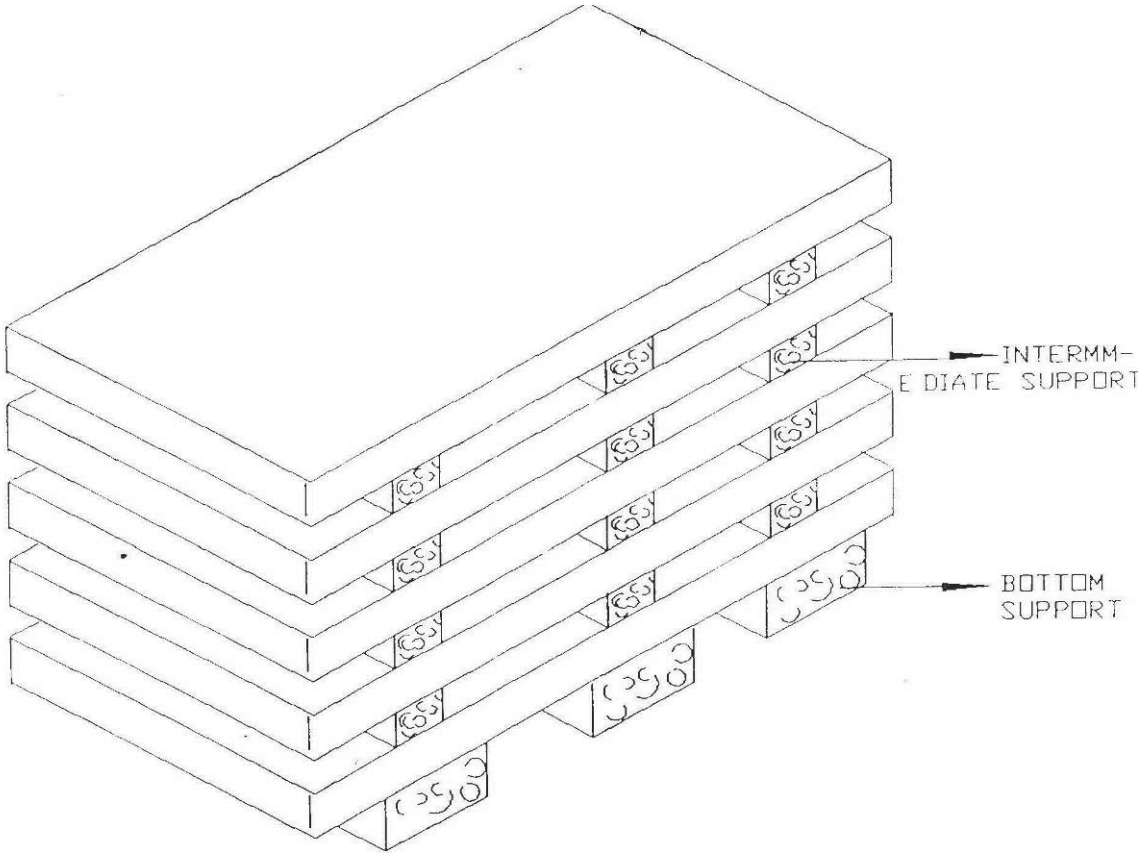

Figure – 1 – PLATE STACKING ARRANGEMENT

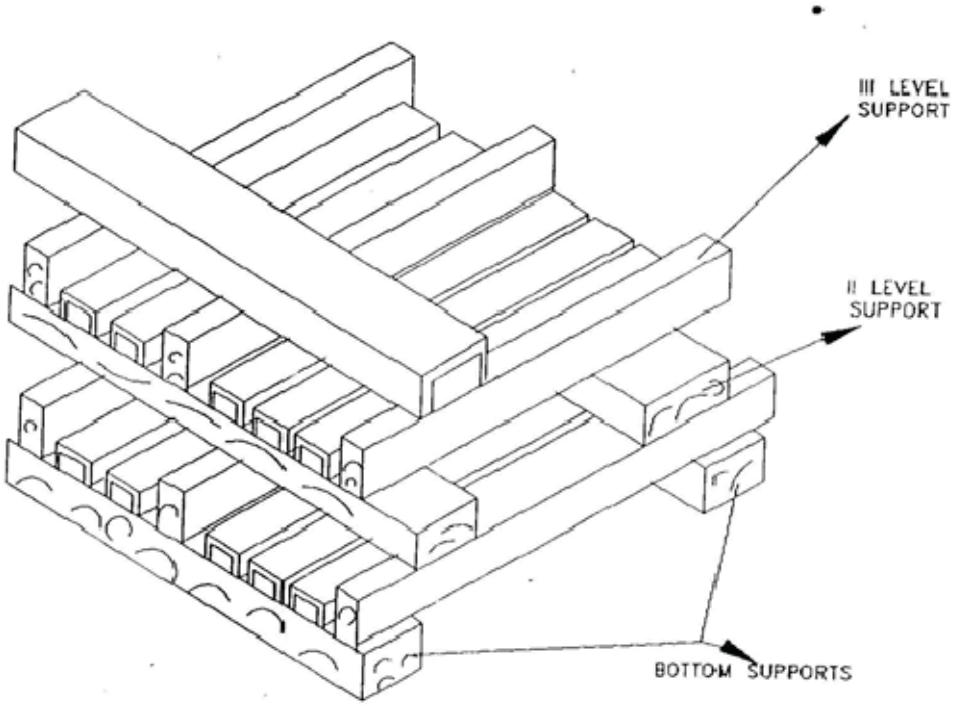

Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

SECTION-II

SUB-SECTION-1

INSPECTION AND TESTING

1.01.00 Inspection and Tests during Manufacture.

1.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.

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

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

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

The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.

The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.

For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.

1.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

1.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.
Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to dispatch from place of manufacture.

1.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory

Regulations shall be certified by a Competent Authority under the regulations in the specified format.

1.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

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

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

Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.

1.02.00 Performance Tests at Site

1.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

1.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

1.02.03 The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

1.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required

QAP FORMAT

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT: SYSTEM :

VENDOR : ITEM :

SL NO	COMPONENT /OPERATION OPERATIONS	CHARACTERISTICS CHECKED	CATEGORY	TYPE /METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

Legend: 1. BHEL 2. Vendor 3. Sub-Vendor

QP No	CQS/SQP/31	Signature	Date		
	Rev		Name		
Page No	1 of 1		Party	Customer/Consultant	Bhel

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

1. Compliance cum confirmation certificate
2. Un priced format for Main package, Mandatory Spares, Tools and Tackles, Commissioning Spares (mentioning quoted/not quoted against each item)
3. Deviation schedule /No deviation certificate in attached format 'Deviation sheet (Cost of withdrawal)'.

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

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

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site

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

j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

PRE-BID CLARIFICATION SCHEDULE

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

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

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

ANNEXURE-II: DEVIATION SHEET (COST OF WITHDRAWAL)

PROJECT:- RAMAGUNDAM STPS (R&M) STAGE-I (3x200MW)

PACKAGE:- HVAC System

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME				**DESIGNATIONS**		**SIGN & DATE**			

NOTES:

1. Cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
3. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
4. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable. In the absence of same, such deviation(s) shall not be considered and offer shall be considered in total compliance to NIT.
5. Bidder shall furnish price copy of above format along with price bid.
6. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
7. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
8. For deviations w.r.t. Credit Period, Liquidated damages, Firm prices if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VII, will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
9. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be considered.
10. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
11. Cost of withdrawal is to be given separately for each deviation. In no event bidder should cub cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
12. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
13. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

SECTION II

SUB-SECTION: 6

Reference Drawing/Documents

PROJECT : RAMAGUNDAM STPS STAGE-I (3x200 MW) ESP R&M	
Main Customer - National Thermal Power Corporation Limited	
Main Contractor - Bharat Heavy Electrical Ltd. ,Power Sector, PEM, Noida	
Sub Contractor - EFE Works	
SUB: INSPECTION CATEGORIZATION PLAN FOR AC PACKAGE	

SL NO.	ITEM	MAKE	CATEGORY OF INSPECTION	Remarks
1	PACKAGE AC	VOLTAS/BLUE STAR/CARRIER	I	
2	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR/ ADVANCE/ HYDERABAD POLLUTION/ SK SYSTEM	III	
3	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF / JYOTI / LHP / BHARAT ELECTRIC	III	
4	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC	III	
5	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)	III	
6	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET	III	
7	SPLIT AIR CONDITIONER	VOLTAS, BLUE STAR, CARRIER, HITACHI,LG	III	
8	INSULATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT / ARMAFLEX / SUPREME / LLOYDS / UP TWIGA/ AEROCELL	III	
11	G.I SHEET FOR DUCTING	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL	III	
12	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL	III	
13	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN	III	
14	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO	III	
15	PRESSURE GAUGE / DP GAUGE	GENERAL INST CONSORTIUM / BELL / H.GURU INST/ H GURU / WAAREE INSTRUMENTS / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES/ PRECISION MASS PRODUCTS/ BOSE PANDA INSTRUMENTS PVT. LTD.	III	
16	PRESSURE SWITCHES / DIFFERENTIAL PRESSURE SWITCH	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT / DELTA CONTROL/ KASTURBA UDYOG/ PRECISION MASS PRODUCTS/ MITTAL REFRIGERATION	III	
17	TEMPERATURE GAUGE	H.GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA / ASHCROFT / H GURU (SI) / BUDENBERG GUAGE CO.LTD./ GOA THERMOSTATIC INSTRUMENTS PVT.LTD./ GAUGE BOURDON INDIA PVT. LTD/BAUMER TECHNOLOGOIES INDIA PVT. LTD./ PRECISION MASS PRODUCTS.	III	
18	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS	III	

PROJECT : RAMAGUNDAM STPS STAGE-I (3x200 MW) ESP R&M	
Main Customer - National Thermal Power Corporation Limited	
Main Contractor - Bharat Heavy Electrical Ltd. ,Power Sector, PEM, Noida	
Sub Contractor - EFE Works	
SUB: INSPECTION CATEGORIZATION PLAN FOR AC PACKAGE	

SL NO.	ITEM	MAKE	CATEGORY OF INSPECTION	Remarks
19	LEVEL SWITCH-	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V ATUOMATE /CHEMTROLS / SIMENS / FLOW STAR / TRAC/ FLOW TECH/ NIVO CONTROLS/ PUNE TECHTROL/ SAPCON INSTRUMENT/ BAUMER TECHNOLOGIES INDIA PVT. LTD./ GIC	III	
20	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)	III	
21	POWER CABLE	CORDS/PARAMOUNT/UNIVERSAL CABLE/TORRENT/RADISON/POLYCAB/NICCO/RADIANT CABLE/KEI/INCAB/HAVELS/HVPL/DELTON/R.R.KABLE/ELKAY TELELINK/KEC INTERNATIONAL/ RAVIN CABLE/THERMOCABLES/SUYOG CABLES/SRI RAM CABLES/SBEE CABLES/ TIRUPATI PLASOMATICS/ADVANCE CABLE/FINOLEX CABLE/ GUPTA POWER/STEP INDUSTRIES/SCOTT INNOVATION WIRES & CABLES/	III	
22	CONTROL CABLE	CORDS CABLE/HVPL/GEMS CAB/KEI/RADIANT/RAILISON/ELKAY TELELINK/POLYCAB/NICCO/TORRENT/UNIVERSAL CABLE/DELTON/RR KABLE/PARAMOUNT CABLE/HAVELLS/GUPTA POWER/SPM CABLES/RAVIN CABLES/SUYOG CABLES/INCAB/THERMOCABLES/TIRUPATI PLASOMATICS/ADVANCE CABLE/FINOLEX/KEC INTERNATIONAL/SBEE CABLES/STEP INDUSTRIES/ SCOTT INNOVATION WIRES AND CABLES	III	
23	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS	III	
24	GIU	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB/ MITSUBISHI ELECTRIC	III	

NOTE : -

Category-I-:-Most Critical Items: QAP will be submitted to BHEL /NTPC for approval. Inspection activities will be jointly witnessed by BHEL /TPA and NTPC as per approved QAP witness/hold points.

Category-II-:- QAP will be submitted to BHEL /NTPC for approval. Inspection activities will be jointly witnessed by BHEL /TPA and witnessed by NTPC at their discretion as per approved QAP witness/hold points.

Category-III:-These are non QAP items and shall be accepted by BHEL /NTPC on the basis of review of manufacturer's test certificate/ certificate of compliance/internal inspection reports/guarntee certificate etc.However despatch clearance shall be issued by NTPC after reviewing manufacturer's test certificate/certificate of compliance/internal inspection report/guarntee certificate etc.

VOLTAS A TATA Enterprise	TECHNICAL DATA SHEET - AIR COOLED PACKAGE UNIT (NEW LOOK PAC R407C)		
Sr No	Parameter	Unit	Value
1	UNIT	Indoor unit model number		ACDPUASC1702P
2		Outdoor unit model number***		ACDC90 X 2
3		Power Supply (to IDU)	Ph-V-Hz	3 Ph - 415 V - 50 Hz - 4 Wire (R,Y,B,N)
4	PERFORMANCE	Unit Nominal Cooling Capacity (at 45 Dig, ambient)	Btu/Hr	193800 (17 TR)
5			KW	56.8
6		Indoor Airflow		
7		High	CMH	11560
8		TSP @ High Speed	mm WG	35
9	Compressor	Type		Hermetic Scroll
10		Qty	Nos	2
11		Rated Speed	RPM	2900
12		Lubricant		PVE
13	Indoor Fan Motor	Make		Voltas approved
14		Power Output	W	2230 (3 HP)
15		Power Supply To Fan Motor	Ph-V-Hz	3 Ph-415 V-50 Hz
16		No of Poles / RPM	Nos / RPM	4 / 1425
17	Indoor Coil	Number of Rows	nos	3
18		Fin Type / Material		Aluminium / Hydrophillic Blue
19		Tube Type / Material		Copper IGT
20	Blower Indoor Unit	Type of blower		Centrifugal DIDW, Forward curved
21		Make of blower		Voltas approved
22		No off Blowers	Nos	1
23	Indoor Unit Dimensions	Unit		
24		Length	mm	1427
25		Height	mm	1872
26		Depth	mm	800
27		Packing		
28		Length	mm	1527
29		Height	mm	1922
30		Depth	mm	850
31	Outdoor Fan	Diameter	mm	600
32		Material		ABS Glass Filled Plastic
33	Outdoor Fan Motor	Make		Voltas approved
34		Power supply	Ph-V-Hz	1 Ph- 230 V - 50 Hz
35		Power Output	W	370
36		Number of Motors / ODU	Nos	1
37		Speed	RPM	890
38	Outdoor Coil	Number of Rows	nos	2
39		Fin Spacing	mm	1.6 (16 FPI)
40		Fin Type / Material		Aluminium / Hydrophillic Blue
41		Tube Type / Material		Copper IGT
42	Expansion Device	Type		TEV
43		Make		Voltas approved
44		Qty	mm	2
45	Outdoor Unit Dimensions	Unit		
46		Length	mm	1200
47		Height	mm	960
48		Depth	mm	450
49		Packing		
50		Length	mm	1300
51		Height	mm	1010
52		Depth	mm	500
53	REFRIGERANT	Refrigerant Type		R-407 C
54		Refrigerant Quantity	g	Not factory Charged
55	Refrigerant Piping	Liquid Line Size	mm	15.8
56		Suction Line Size	mm	28.5
57		Discharge Line	mm	19
58	Filter (Pre Filter)	Length	mm	1229
59		Height	mm	916
60		Thickness	mm	6
61		No of filters / unit	nos	1
62		Material of Filter		HDPE/Nylon Washable
63		Material of Frame		MS

NOTES

1) THE RATED VALUES ARE AT INDOOR CONDITIONS OF 27 DBT/ 19 WBT AND OUTDOOR CONDITIONS OF 35 DBT / 24 WBT
2) PACKING AND WEIGHT DIMENSIONS ARE APPROXIMATE AND FOR INDICATION PURPOSE ONLY
3) THE ABOVE SPECS ARE SUBJECT TO CHANGE WITHOUT NOTICE AS PRODUCT REVISONS AND DEVELOPMENT IS A CONTINOUS PROCESS IN VOLTAS
4) INDOOR UNITS MODEL NUMBER (ACDPU ASC17O2P = 17TR) / OUTDOOR UNITS MODEL NUMBER ACDC90X2 (8.5 TR X2)
5) INDOOR CONDITION SELECTED27 DBT / 19WBT.OUT DOOR CONDITION SELECTED 35 DIGREE C AT 35 DBT / 24 WBT SELECTED TR 45DIGREE WB 27.5 15.3TR
6) ACTUAL TR RATING 15.3 TR AT DESIGN CALCULATION BASIS BUT WE HAVE SELECTED 17 TR MACHINE , (AS PER TECHNICAL 15 TR AT NORMAL CONDITION)