KAHALGAON SUPER THERMAL POWER STATION STAGE-I (4x210 MW) R&M OF ESP PACKAGE)

TECHNICAL SPECIFICATION

FOR SUPPLY & SERVICES OF

AIR-CONDITIONING & VENTILATION SYSTEM

SPECIFICATION NO.: PE-TS-455-571-15000A-A001 (REV-00)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR-PROJECT ENGINEERING MANAGEMENT
POWER PROJECTS ENGINEERING INSTITUTE
PLOT NO. 25, SECTOR-16A, NOIDA-201301 (U.P.), INDIA

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INTENT OF SPECIFICATION

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1.0 INTENT OF SPECIFICATION

1.1 The specification covers design (i.e. preparation and submission of drawings/documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable) fill of lubricants & consumables, spares for erection, start-up and commissioning as required, forwarding, proper packing, shipment and delivery at site, handling, in-site transportation, assembly, erection & commissioning, commissioning spares, minor civil work, trial run at site and carrying out Demonstration tests at site (As applicable), training of customer/ client and handover in flawless condition of the package to the end customer 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 HVAC System of **KAHALGAON STPS STAGE-I (4x210MW) (R&M OF ESP PACKAGE).**

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and 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 demonstration testing of Air conditioning and Ventilation System (**HVAC) SYSTEM.**

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

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system and notwithstanding 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 Sub-section-4 of Section-II of this 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 as per Sub-section-5 of Section-II of this specification 'Deviation sheet (Cost of withdrawal)', 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, Sub-section-C1 of Section-I of this specification shall prevail over others, 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 be liable for rejection.

1.11 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder/ vendor and Customer/ Purchaser/ Employer will mean BHEL and / or customer including their consultant as interpreted by BHEL in the relevant context. For details refer the relevant clause in GCC.

1.12 Bidder to mandatorily visit site for assessment of work prior to quoting.

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SECTION: I

SUB-SECTION: B

PROJECT INFORMATION

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1. PROJECT INFORMATION

Kahalgaon Super Thermal Power Station (Khstps) is located in the district Bhagalpur of Bihar State. The Station is around 250km from the state capital Patna. The station is having four (4) units of 210MW each with a total installed capacity of 840MW; Stage-I comprising 4 units commissioned in the year 1992-96. Stage–I Units (U#1, U#2, U#3 & U#4) have completed around 20-24 years of service

In line with the pollution control norms, NTPC now intends taking up Renovation & Modernization (R&M) and augmentation work on these existing ESP's of (4x210MW) units, along with Retrofitting of ESPs by enhancement of their Collection Area, so that these units are able to comply with the particulate emission control norms prevailing in the area under various operating conditions / contingencies. This specification is intended for such R&M of four (4) sets of Electrostatic Precipitators of 4x210 MW units of KhSTPS.

2. The current work involves renovation of the ESPs at Site which is being executed by BHEL. The bidder's scope pertains to the supply and erection & commissioning 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

01.00.00 INTENT OF SPECIFICATION

This specification presents the general description, technical requirements, and broad scope of supply, erection, testing and commissioning of HVAC system as specified for 4 X 210 MW STAGE-I ESP R&M NTPC KAHALGAON for ESP Control Rooms.

Equipment, systems and services to be furnished in accordance with this specification shall include design, engineering, manufacturing, painting & corrosion protection, inspection & testing at manufacturer's works, packing, inland transport, erection, testing commissioning, trial run, performance testing, co-ordination & project management and handing over the same to the owner in accordance with the requirements, datasheets, conditions, Annexed drawings, etc. as stated in the specification. The equipment shall, in general, conform to relevant IS/ASME/ANSI/BS/ISO codes.

SYSTEM DESCRIPTION

02.00.00 SCOPE OF SUPPLY & SERVICES FOR EACH UNIT

Design, manufacturing, supply, handling of supplied material at site from store to work place, erection, testing and commissioning of the air conditioning and ventilation system as per the scope listed below:

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

02.01.02 Necessary heating and humidification should be provided.

02.01.03 Industrial type ventilation fans (Supply air fans fitted with filters and gravity damper and exhaust fans) for Non- AC areas of ESP Control room Building, complete with starter unit, cowl and bird/insect protection, pre-filters and fine filters as applicable as per latest industry practices.

02.01.04 Required power and control cables as required for the above ACs and ventilation fans. This also includes incoming power cable required from incoming source to required power distribution board for the AC and ventilation fans. Power distribution board is in scope of supply of bidder.

02.01.05 Other accessories as mentioned in the specification and as required for completion of the AC and Ventilation system.

02.01.06 Make for various items will be subjected to BHEL/NTPC approval. Refer make list (Annexure-II) which should be adhered strictly.

02.01.07 Commissioning spares shall be supplied by the bidder along with main equipment.

02.01.08 Minor civil works if required at site to will be in scope of bidder.

02.01.09 Successful bidder shall be required to submit the Datasheets, GA drawings, QAP as applicable for approval by BHEL/NTPC.

02.01.10 Control System for Air conditioning system shall be as per microprocessor/ PLC/ GIU based. Refer clause no. 4.09.00 of customer specification.

2.2 DESIGN CONDITIONS/DESIGN PHILOSOPHY CONSIDERED

2.2.1 AIR CONDITIONING SYSTEM

SYSTEM DESIGN PARAMETER

a) The outside design conditions considered are as follows:

	Summer	Monsoon	Winter
DBT (°C)	43	38	7
WBT (°C)	27.5	29.5	5.8

b)The inside design conditions to be maintained are as follows: -

Temperature : 24 ± 1°C

Relative humidity : 50% ± 5%

2.2.2 VENTILATION SYSTEM

The number of air charges per hour in mechanically ventilated areas considered:

Non air conditioned Switchgear Room	20ACPH

The temperature is also the criteria which is as follows:

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

All mechanically ventilated areas are to be positively ventilated by means of supply air fans fitted with filters and gravity operated back draft dampers and wall mounted/roof mounted exhaust fans. Supply air fans catering for containerized control rooms shall be fitted with both pre filters and fine filters. The ventilation system shall be provided by wall mounted supply air fans and exhaust fans.

3. GENERAL DESIGN PHILOSOPHY CONSIDERED (AC & VENTILATION SYSTEM) TO BE FOLLOWED BY BIDDER

3.1 All the equipment of air-conditioning & ventilation system shall be designed for continuous duty.

3.2 Noise level within the air conditioned space shall be restricted to 35-45 NC level with suitable acoustic attenuation (with duct silencer, acoustic insulation).

3.4 All GI sheets used under AC & Ventilation system shall be galvanized to grade 275 of IS:277.

3.5 The fan capacity considered is at static pressure of **30 mmWC** for supply and **10 mmWC** for exhaust**.**

4. STANDARDS AND OTHER REQUIREMENTS

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 mentioned elsewhere in this specification.

Relevant IS published by the Bureau of Indian Standards shall be followed. Where suitable Indian Standards are not available, equipment shall conform to generally accepted codes & practices.

All items of equipment shall comply with the stipulations of Inspectorate of Factories and other statutory bodies of Government of India and Chief Electrical Inspectorate of the State in which the plant site is located, wherever applicable. Wherever required, the successful Bidder has to obtain the necessary approvals from statutory authorities and other concerned agencies. All cost on these accounts shall be borne by the successful Bidder.

5. TECHNICAL SPECIFICATION

Air cooled Package Air Conditioner

Air cooled Package A/C units shall be provided for all the Control Panel Areas/ AC Areas marked in the drawings. All the package 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 Air Conditioning units consisting of:

- Hermetic sealed 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 A/C 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 package 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.

5.2 VENTILATION FANS

5.2.1 AXIAL FLOW FANS

a) These fans shall have single piece cast aluminium impeller with blades of aero foil design. It shall be finished all over and balanced dynamically as per AMCA standard. Impeller shall be mounted directly on the motor shaft.

b) The fan casing shall be of heavy gauge construction, properly reinforced for rigidity. It shall be provided with suitable supports. Access door shall be provided in the casing for easy access to motor and impeller Suitable arrangement for mounting the motor shall be provided.

c) Rain protection cowls will be designed to suit wall mounted air supply fans for protecting fans/motors from rain. It shall be provided with bird screen.

d) Inlet cone or bell & outlet cone shall be provided.

e) Accessories such as bird protection screen, inlet louvers vibration, isolators, back draft dampers etc. shall be provided as per requirement.

f) Motors shall be totally enclosed type, complying with the electrical specification (sub-section C2 of Section-I).

g) The speed of the fan shall not exceed 960 rpm for fan with impeller diameter above 450 mm and 1440 rpm for fan with impeller diameter 450 mm and 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 dia. above 450 mm and 2800 rpm for fan with impeller diameter 450 mm and less. The first critical speed of rotating assembly shall be at least 25% (percent) above rated speed.

6. LIST OF DRAWINGS AND DOCUMENTS (MINIMUM REQUIREMENT)

The successful Bidder shall prepare and submit the drawings and documents as per schedule mentioned in the Annexure-III & IV of Sub-Section-E of Section-I:

7. START-UP AND COMMISSIONING

The start-up of the system shall be carried out by the supplier to establish satisfactory functioning of the system as a whole and of each equipment as part of the system.

During commissioning all the equipment pertaining to the AC and Ventilation system shall be put into operation in an integrated manner. All parameters shall be checked with respect to approved documents/ tender spec and shall be recorded. All arrangement of commissioning shall be made by the Bidder. Complete commissioning for Air conditioning & Ventilation System is in bidder's scope.

8. TAKING OVER OF AC & VENTILATION SYSTEM

Bidder shall submit the following documents in English language only before handing over the equipments (6 sets of Hardcopies with along with softcopy):

a) AS-BUILT drawings
b) Operation, maintenance & service manual including periodic maintenance schedule
c) Safety instructions.
d) List of tools & tackles.
e) Demonstration test results copy.

In case, BHEL's Customer demands additional copies and/or in a different format, the same shall be furnished by the bidder.

9. TERMINAL POINTS

1. BHEL shall provide Two Electrical incomer source. Further complete Elect distribution boards, LPBS, Cable trays, tray support, Termination & jointing kit, cabling items, above ground earthing, LT power cables, LT control cables, screen control cables etc. for completeness of HVAC system shall be bidder's scope as per specification:
2. For Electrical scope, refer Electrical specification (Sub-section- C2 of Section-I).

10. LIST OF REFERENCE DRAWINGSL

The drawings specified in Sub-section-6 of Section-II are being provided along with the tender specification for estimation and calculation purpose of the bidder.

11. PAINTS /PAINTING

Please refer customer specifications clause no. 4.10.00 of Part-B Sub Section-I-M3

12. CONSUMMABLES FOR THE FIRST FILL

The Supplier's scope of work includes the supply of all applicable first fill required for completeness of all the equipments covered herein. All the first fill and one years topping requirements of consumable such as grease, oil, lubricants servo fluids, essential chemicals etc. which will be required to put the equipments covered under the scope of specifications, into successful commissioning / initial operation and to establish completion to facilities shall be furnished by the Contractor.

13. Slab/wall cut out for cables, grilles/dampers, AC Duct, AC & Fans, sealing and finishing of wall opening, grouting of foundation bolts including special type of grouting like GPX2 etc. are in the scope of the supplier. Further necessary support structure for duct, Fans, Pipe shall also be in the scope of the supplier.

14 Dismantling of existing AHUs, accessories etc. in existing ESP Control Room shall be bidders scope of work. Dismantle material shall be hand over to owner at identify location.

15. **EXCLUSIONS**

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

a) False ceiling, drop ceiling, foundation for Package AC.

16. **PACKING**

Supplier shall ensure proper packing for Site storage and preservation. The equipment supplied should be packed to avoid transit damage.

SECTION: I

SUB-SECTION: C 2

CUSTOMER SPECIFICATION

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC

Clause No.	Description
1.00.00	General
2.00.00	Design Philosophy
3.00.00	Equipment Description – Air Conditioning System
4.00.00	Balance Equipment Specification

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

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 units of 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**

1. 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 /Sq.m on the surface.

2. 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.

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

4. 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 or	Roll /Slab	50	F-3

Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
		Closed Cell Elastomeric Nitrile Rubber Or FR Closed Cell Chemically Cross Linked Polyethylene (XLPE) with Al foil face	sheet Roll	19 19	As per manufacturer std. F-3(a)
2.	Refrigerant (Suction and liquid lines)	Closed Cell Elastomeric Nitrile Rubber Or FR Closed Cell Chemically Cross Linked Polyethylene (XLPE)	Tube Pre-formed tube/roll	19 19	As per manufacturer std. F-1(a)
3.	AHU drain pipe	Closed Cell Elastomeric Nitrile Rubber Or FR Closed Cell Chemically Cross Linked Polyethylene pre formed tubing (XLPE)	Tube Pre-formed tube	19 19	As per manufacturer std. F-1(a)
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	Slab Sheet	25 15	As per manufacturer std. F-1(a)

Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
		face			
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^{o}C	Rockwool – 144 Glasswool - 90
Closed Cell Elastomeric Nitrile Rubber		0.034 at 20^{o}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 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

4.10.00 **PAINTING:**

4.10.01 All the Equipment 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

ELECTRICAL SPECIFICATION

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure–I to Section –I [Scope of Work (Electrical)].

1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.

1.3 Bidder shall furnish all AC as well as DC loads required for the system at different voltage levels (eg. 415V AC, 240 V AC, 220 V DC etc.) of all types, such as motor feeders, supply feeders in PEM format along with the offer.

1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.

1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage as per formats enclosed. The same shall be subject to approval without any commercial implications.

1.6 Technical requirements shall be as per specifications listed in Clause 3.1 to 3.6. In case of any discrepancy between NTPC specification and BHEL standard specification, NTPC specification shall prevail.

2.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

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

3.0 LIST OF ENCLOSURES

3.1 Electrical scope between BHEL & vendor.
3.2 Technical specification of motors, lt swgr, cables, cabling (NTPC)
3.3 BHEL standard specification for LT motors
3.4 Datasheets – C for motors
3.5 Quality Assurance/Plan for motors, lt swgr, cables, cabling.

SUB-SECTION-II-E-02

MOTORS

MOTORS

1.00.00 GENERAL REQUIREMENTS

1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

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

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

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

1.05.00 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.

1.06.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances for contractors equipment and systems shall be under the contractor scope.

1.07.00 Degree of Protection

Degree of protection for various enclosures as per IS:4691, IEC60034-05 shall be as follows :-

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

2.00.00 CODES AND STANDARDS

1)	Three phase induction motors	:	IS:325, IEC:60034
2)	Single phase AC motors	:	IS:996, IEC:60034
3)	Crane duty motors	:	IS:3177, IEC:60034
4)	DC motors/generators	:	IS:4722, IEC:60034
5)	Energy Efficient motors	:	IS 12615, IEC:60034-30

3.00.00 **TYPE**

3.01.00 **AC Motors:**

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

b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg.C ambient temperature), shall be **Premium Efficiency class-IE3**, conforming to IS 12615, or IEC:60034-30.

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

3.02.00 DC Motors Shunt wound.

4.00.00 **RATING**

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

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

(c) For BFP motors starting MVA shall be restricted to 60 MVA.

5.00.00 **TEMPERATURE RISE**

Air cooled motors

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

Water cooled

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

6.00.00 **OPERATIONAL REQUIREMENTS**

6.01.00 **Starting Time**

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

6.01.02 For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.

6.01.03 For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.

6.01.04 Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.

6.02.00 **Torque Requirements**

6.02.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

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

6.03.00 **Starting voltage requirement**

(a) Up to 85% of rated voltage for ratings below 110 KW

(b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW

(c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW

(d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW

(e) Up to 75 % of rated voltage for ratings above 4000KW

Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.

7.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

7.01.00 Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.

7.02.00 All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below

(a) Fuel oil area : Group – IIB

(b) Hydrogen generation :Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034)

7.03.00 Winding and Insulation

(a)	Type	:	Non-hygroscopic, oil resistant, flame resistant
(b)	Starting duty	:	Two hot starts in succession, with motor initially at normal running temperature.
(c)	6.6 kV AC motors	:	Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Presure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15.
(d)	240VAC, 415V AC & 220V DC motors	:	Thermal Class (B) or better

7.04.00 Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.

7.05.00 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.

7.06.00 Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.

7.07.00 In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and preferably 2 numbers duplex platinum resistance type temperature detectors.

7.08.00 Motor body shall have two earthing points on opposite sides.

7.09.00 HT motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. In case cable box is offered, then contractor shall provide termination kit. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.

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

7.12.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.15.00	6.6 KV Terminal Box shall be suitable for fault level of 500MVA for 0.12 second. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor. (a) Below 110KW : 10.0 (b) From 110 KW & upto 200 KW : 9.0 (c) Above 200 KW & upto 1000KW : 10.0 (d) From 1001KW & upto 4000KW : 9.0 (e) Above 4000KW : 6 to 6.5
9.00.00	CW Motor shall be designed with minimum power factor of 0.8 at design point.
10.00.00	**TYPE TEST**
10.01.00	**HT MOTORS**
10.01.01	The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.
10.01.02	The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
10.01.03	In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the employer for waival of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either

conducted at an independent laboratory or should have been witnessed by a client. The employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.

10.01.04 Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED "and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the employer either at third party lab or in presence of client/ employer's representative and submit the reports for approval.

10.01.05 **LIST OF TYPE TESTS TO BE CONDUCTED**

The following type tests shall be conducted on each type and rating of HT motor

(a) No load saturation and loss curves upto approximately 115% of rated voltage

(b) Measurement of noise at no load.

(c) Momentary excess torque test (subject to test bed constraint).

(d) Full load test (subject to test bed constraint)

(e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp.,coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

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

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

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

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

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

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

10.02.00 **LT Motors**

10.02.01 LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for employer's approval the reports of all the type tests as listed in this specification and carried out within last *ten* years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

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

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

The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only

1. Measurement of resistance of windings of stator and wound rotor.
2. No load test at rated voltage to determine input current power and speed
3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
4. Full load test to determine efficiency power factor and slip.
5. Temperature rise test.
6. Momentary excess torque test.
7. High voltage test.
8. Test for vibration severity of motor.
9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section)
10. Test for degree of protection and

11. Overspeed test.

12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

10.03.00 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

10.04.00 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

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

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

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

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

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

SUB-SECTION-II-E-06

LT POWER CABLE

1.00.00 CODES & 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 as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D –2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

2.00.00 TECHNICAL REQUIREMENTS

2.01.00 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2.02.00 All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.

2.03.00 Conductor of control cables shall be made of stranded, plain annealed copper.

2.04.00 PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

2.05.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other

than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.

2.06.00 For multicore armoured cables, the armouring shall be of galvanised steel as follows:

Calculated nominal dia of cable under armour	Size and Type of armour
Upto 13 mm	1.4mm dia GS wire
Above 13 upto 25 mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 upto 55mm	1.4 mm thick GS formed wire/2.5mm dia GS wire
Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.

2.07.00 Outer sheath shall be of PVC as per IS: 5831 and grey in colour. In addition to meeting all the requirements of Indian Standards referred to, outer sheath of all the cables shall have the following FRLS properties.

(a.) Oxygen index of min. 29. (As per IS 10810 Part-58)

(b.) Acid gas emission of max. 20% (As per IEC-754-I)

(c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTMD-2843.

2.08.00 Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.

1 core - Red, Black, Yellow or Blue

2 core - Red & Black

3 core - Red, Yellow & Blue

4 core - Red, Yellow, Blue and Black

5 core - Red, Yellow, Blue, Black and Grey

2.09.00 For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed

underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.

2.10.00 In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath:

(a.) Cable size and voltage grade - To be embossed

(b.) Word 'FRLS' at every 5 metre - To be embossed

(c.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed.

The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.

2.11.00 All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.

2.12.00 Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum over the declared value in the technical data sheets.

2.13.00 In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.

2.14.00 Cable selection & sizing

Control cables shall be sized based on the following considerations:

(a) The minimum conductor cross-section shall be 1.5 sq.mm.

(b) The minimum number of spare cores in control cables shall be as follows:

No. of cores in cable	Min. No. of spare cores
2C, 3C	NIL
5C	1
7C-12C	2
14C & above	3

2.14.01	Cable lengths shall be considered in such a way that straight through cable joints are avoided.
2.14.02	Cables shall be armoured type if laid directly buried.
3.00.00	**CONSTRUCTIONAL FEATURES**
3.01.00	1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).
3.02.00	1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propyline Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968. Minimum conductor size shall be 2.5 sqmm.
4.00.00	**CABLE DRUMS**

(a.) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

(b.) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

(c.) The standard drum length for control cables shall not be less than 1000 metres. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths.

5.00.00 TESTS

All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

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

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price

The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

5.01.00 **TYPE TESTS**

5.01.01 The reports for the following type tests shall be submitted for one size of control cables. Size shall be decided by the employer during detailed engineering

S. No.	Type Test	Remarks
	For Conductor	
1.	Resistance test	
	For Armour Wires / Formed Wires (If applicable)	
2.	Measurement of Dimensions	
3.	Tensile Test	
4.	Elongation test	
5.	Torsion test	For round wire only
6.	Wrapping test	For aluminium wires / formed wires only.
7.	Resistance test	
8(a).	Mass of zinc Coating test	For GS wires/formed wires only
8(b).	Uniformity of zinc coating	For GS wires/formed wires only
9.	Adhesion test	For GS wires/formed wires only

S. No.	Type Test	Remarks
	For PVC insulation & PVC Sheath	
10.	Test for thickness	
11.	Tensile strength and elongation test	before ageing and after ageing
12.	Ageing in air oven	
13.	Loss of mass test	For PVC insulation and sheath only
14.	Hot deformation test	For PVC insulation and sheath only
15.	Heat shock test	For PVC insulation and sheath only
16.	Shrinkage test	
17.	Thermal stability test	For PVC insulation and sheath only
18.	Oxygen index test	For outer sheath only
19.	Smoke density test	For outer sheath only
20.	Acid gas generation test	For outer sheath only
	For completed cables	
21.	Insulation resistance test(Volume resistivity method)	
22.	High voltage test	
23.	Flammability test as per IEC-332 Part-3 (Category-B)	

5.02.00 Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Control Cables enclosed.

SUB-SECTION-II-E-07

LT CONTROL CABLE

1.00.00 CODES & 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 as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D –2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

2.00.00 TECHNICAL REQUIREMENTS

2.01.00 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2.02.00 All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.

2.03.00 Conductor of control cables shall be made of stranded, plain annealed copper.

2.04.00 PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

2.05.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other

than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.

2.06.00 For multicore armoured cables, the armouring shall be of galvanised steel as follows:

Calculated nominal dia of cable under armour	Size and Type of armour
Upto 13 mm	1.4mm dia GS wire
Above 13 upto 25 mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 upto 55mm	1.4 mm thick GS formed wire/2.5mm dia GS wire
Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.

2.07.00 Outer sheath shall be of PVC as per IS: 5831 and grey in colour. In addition to meeting all the requirements of Indian Standards referred to, outer sheath of all the cables shall have the following FRLS properties.

(a.) Oxygen index of min. 29. (As per IS 10810 Part-58)

(b.) Acid gas emission of max. 20% (As per IEC-754-I)

(c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTMD-2843.

2.08.00 Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.

1 core - Red, Black, Yellow or Blue

2 core - Red & Black

3 core - Red, Yellow & Blue

4 core - Red, Yellow, Blue and Black

5 core - Red, Yellow, Blue, Black and Grey

2.09.00 For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed

underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.

2.10.00 In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath:

(a.) Cable size and voltage grade - To be embossed

(b.) Word 'FRLS' at every 5 metre - To be embossed

(c.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed.

The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.

2.11.00 All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.

2.12.00 Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum over the declared value in the technical data sheets.

2.13.00 In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.

2.14.00 Cable selection & sizing

Control cables shall be sized based on the following considerations:

(a) The minimum conductor cross-section shall be 1.5 sq.mm.

(b) The minimum number of spare cores in control cables shall be as follows:

No. of cores in cable	Min. No. of spare cores
2C, 3C	NIL
5C	1
7C-12C	2
14C & above	3

2.14.01 Cable lengths shall be considered in such a way that straight through cable joints are avoided.

2.14.02 Cables shall be armoured type if laid directly buried.

3.00.00 CONSTRUCTIONAL FEATURES

3.01.00 1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).

3.02.00 1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propyline Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968. Minimum conductor size shall be 2.5 sqmm.

4.00.00 CABLE DRUMS

(a.) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

(b.) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

(c.) The standard drum length for control cables shall not be less than 1000 metres. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths.

5.00.00 TESTS

All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

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

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price

The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

5.01.00 **TYPE TESTS**

5.01.01 The reports for the following type tests shall be submitted for one size of control cables. Size shall be decided by the employer during detailed engineering

S. No.	Type Test	Remarks
	For Conductor	
1.	Resistance test	
	For Armour Wires / Formed Wires (If applicable)	
2.	Measurement of Dimensions	
3.	Tensile Test	
4.	Elongation test	
5.	Torsion test	For round wire only
6.	Wrapping test	For aluminium wires / formed wires only.
7.	Resistance test	
8(a).	Mass of zinc Coating test	For GS wires/formed wires only
8(b).	Uniformity of zinc coating	For GS wires/formed wires only
9.	Adhesion test	For GS wires/formed wires only

S. No.	Type Test	Remarks
	For PVC insulation & PVC Sheath	
10.	Test for thickness	
11.	Tensile strength and elongation test	before ageing and after ageing
12.	Ageing in air oven	
13.	Loss of mass test	For PVC insulation and sheath only
14.	Hot deformation test	For PVC insulation and sheath only
15.	Heat shock test	For PVC insulation and sheath only
16.	Shrinkage test	
17.	Thermal stability test	For PVC insulation and sheath only
18.	Oxygen index test	For outer sheath only
19.	Smoke density test	For outer sheath only
20.	Acid gas generation test	For outer sheath only
	For completed cables	
21.	Insulation resistance test(Volume resistivity method)	
22.	High voltage test	
23.	Flammability test as per IEC-332 Part-3 (Category-B)	

5.02.00 Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Control Cables enclosed.

1.00.00 **INSTRUMENTATION CABLE, CONTROL & POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL (CABLE SUB-TRAYs ETC)**

1.01.00 **General requirements**

1.01.01 All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.

1.01.02 The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope and ensuring completeness of the control system.

1.01.03 Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.

1.01.04 Other type of cables like fiber optic/co-axial cables for system bus, cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.

1.01.05 Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.

1.01.06 Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sump price without any further cost implication to the Employer.

2.00.00 **SPECIFICATION OF INSTRUMENTATION CABLE**

2.01.00 **Common Requirements**

S. No.	Property	Requirement
1	Opearting Voltage	225 V (peak value)
2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.
3.	Continuous operation suitability	At 70 deg. C for all types of cables, and at 205 Deg C for Type-C cables.

S. No.	Property	Requirement
4.	Marking :- a.*Progressive automatic on-line sequential marking of length in meters to be provided at every one meter on outer sheath.* *b.*Marking to read 'FRLS' to be provided at every 5 meters on outer sheath except for Type-C cable c.Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided on outer sheath.	
5.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet
6.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.
7.	Ovality at any cross-section	Not more than 1.0 mm
8.	CAGE-CLAMP suitability	To be provided
9.	Color	The outer sheath shall be of blue color.
10.	Others	Repaired cables shall not be acceptable.

2.02.00 Specific Requirements

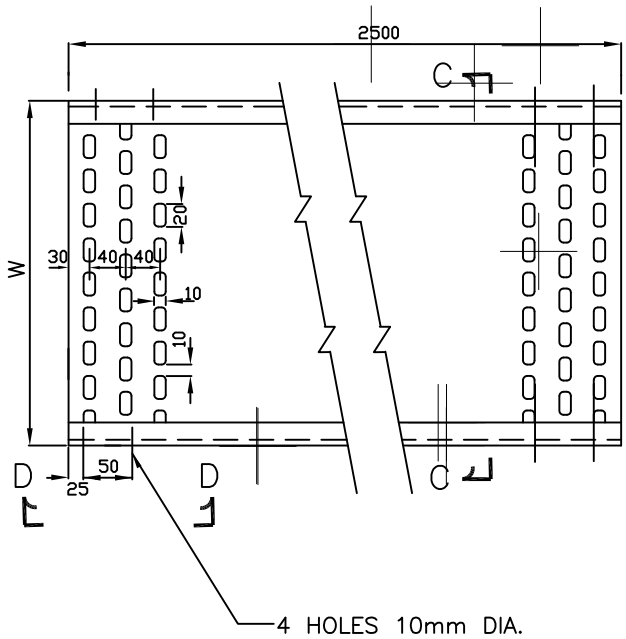
Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
A. CONDUCTORS				
Cross section area	0.5 sq. mm			
Conductor material	ANSI type KX	ANSI type SX	Annealed bare copper	ANSI type KX
Colour code	Yellow-Red	Black-Red	As per VDE-815	Yellow-Red
Conductor Grade	As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1
No & dia of strands	7x0.3 mm (nom)			
No. of Pairs	2	2	2*/4/8/12/16/24/48 * 2 pair cable shall be used from Field to Local JB only.	2

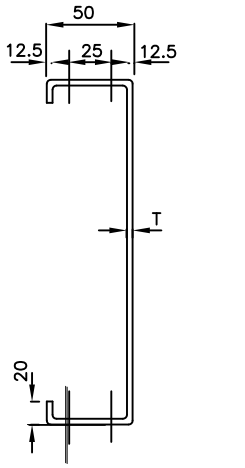
Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
			For connection between field and DDCMIS Marshalling cabinet minimum 4 Pair cable shall be used.	
Max. conductor loop resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4	As per ANSI MC 96.1
Reference Standard	As per ANSI MC 96.1		VDE : 0815	As per ANSI MC 96.1
B. INSULATION				
Material	Extruded PVC type YI 3			Teflon (i.e. extruded FEP)
Thickness in mm (Min/Max)	0.25/0.35			0.4 / 0.50 (nominal)
Volume Resistivity (Min) in ohm-cm	1×10^{14} at 20 deg. C & $1x10^{11}$ at 70 deg. C.			$2.8x\ 10^{14}$ at 20 deg. C & $2x10^{11}$ at 205 deg. C.
C. PAIRING & TWISTING				
Max. lay of pairs (mm)	50			
Single layer of binder tape on each pair provided	Each core printed with number or Numbered binder tape to provided on each pair		Yes	Each core printed with number or Numbered binder tape to be provided on each pair
Bunch (Unit Formation) for more than 4P	N.A		To be provided	N.A
Conductor /pair identification as per VDE0815	N.A.		To be provided	N.A.
D. SHIELDING				
Type of shielding	Al-Mylar tape			

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
Individual pair shielding	No		To be provided for F-type cable	No
Minimum thickness of Individual pair shielding	No		0.028mm (28 micron)	No
Overall cable assembly shielding	To be provided			
Minimum thickness of Overall cable assembly shielding	0.055 mm (55 micron)			
Coverage Overlapping	20%			
Drain wire provided for individual shield	N.A.		Yes (for F-type) Size- 0.5 sqmm No of strands-7 Dia of strands- 0.3mm Annealed Tin coated copper	N.A.
Drain wire provided for overall shield	Yes, Size- 0.5 sqmm, No of strands-7,Dia of strands-0.3mm,Annealed Tin coated copper			
E. FILLERS (if applicable)				
Non-hygroscopic, flame retardant	To be provided			
F. OUTER SHEATH				
Material	Extruded PVC compound YM1 with FRLS properties			Teflon (i.e. extruded FRP)
Minimum Thickness at any point	1.8 mm			0.4 mm
Nominal Thickness at any point	>1.8 mm			0.5 mm
Resistant to water, fungus, termite & rodent attack	Required			
Minimum Oxygen index as per ASTMD-	29 %			N.A.

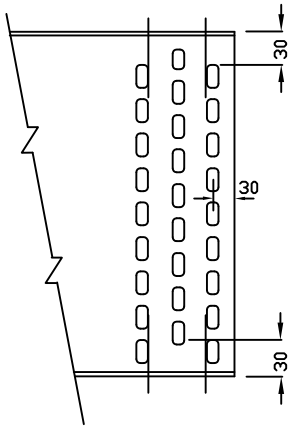
Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
2863				
Minimum Temperature index as per ASTMD-2863	250 deg.C			N.A.
Maximum Acid gas generation by weight as per IEC-60754-1	20%			N.A.
Maximum Smoke Density Rating as per ASTMD-2843	60% (defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)			N.A.
Reference standard	VDE207 Part 5,VDE-816			VDE207 Part 6 ASTM D2116
G. Electrical Parameters				
Mutual Capacitance Between Conductors At 0.8 KHz (Max.)	200 nF/km		120 nF/km for F type 100 nF/km for G-type	200 nF/km
Insulation Resistance (Min.)	100 M Ohm/Km			
Cross Talk Figure (Min.) At 0.8 KHz	60 dB		60 dB	60dB
Characteristic Impedance (Max) At 1 KHz	N.A.		320 OHM FOR F-TYPE 340 OHM FOR G-TYPE	N.A.
Attenuation Figure At 1 KHz (Max)	N.A.		1.2 db/km	N.A.
H. COMPLETE CABLE				
Complete Cable	Shall pass Swedish Chimney test as per			N.A.

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable
assembly	SEN-SS 4241475 class F3.			
Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification			As per manufacturer's standard subject to employer's approval
I. CABLE DRUM				
Type	Non-returnable wooden drum (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to entire drum) or steel drum.			
Length Outermost cable layer covered with water proof paper	1000 m ± 5% for up to & including 12 pairs 500 m ± 5% for above12 pairs Yes			
I. ACCESSORIES				
Cable accessories of flame retardant quality.	Yes. (Accessories such as harnessing components, markers, bedding, cable jointer, binding tape etc.)			

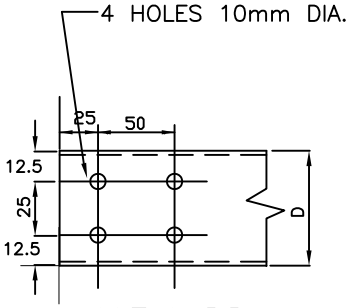




SECTION–CC
(100/50 TRAYS)



ARRANGEMENT OF
PERFORATIONS

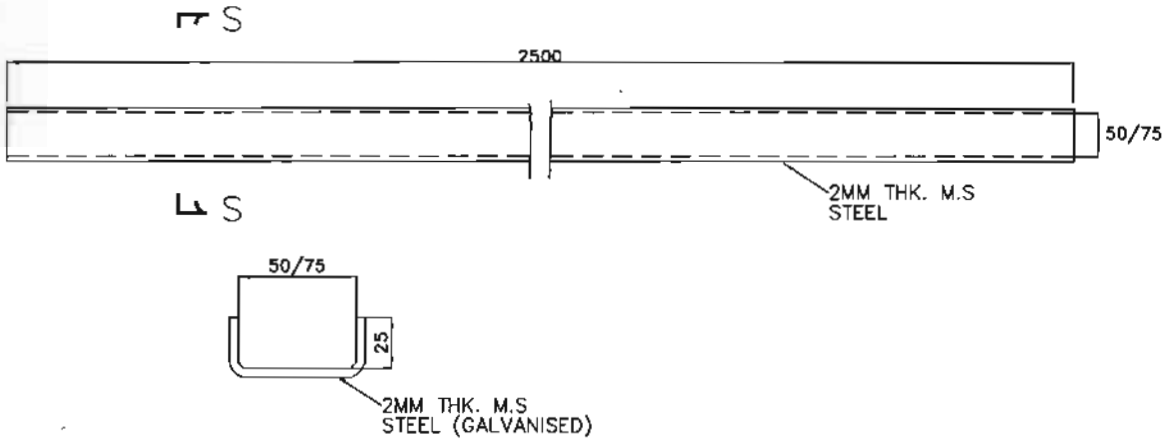


VIEW–DD
(100,50W TRAYS)

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

PERFORATED TYPE TRAY

	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	DWG. NO.



SECTION S–S

CABLE TROUGHS

~~SEE GENERAL NOTES IN SHEET 11.~~

बीएचईएल BHEL	TYPICAL DETAILS OF CABLE TRAY AND ACCESSORIES	BHEL DRAWING NO. ~~PE-DG-427-507-E005~~
		~~SH 10 OF 11~~ REV 00

SUB-SECTION-II-E-05

LT SWITCHGEAR ~~& BUSDUCT~~

1.00.00 **GENERAL REQUIREMENTS**

1.01.00 The requirements, conditions, appendices etc stated in any other bid documents shall apply to and shall be considered as a part of this specification as if bound together. In case of any discrepancy between conditions specified in any other volume and this volume, the requirements, specified in this volume shall prevail.

1.02.00 The equipment offered by the Bidder shall be complete in all respects. Any material and component not specifically stated in this specification but which is necessary for trouble free operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded. All such equipment / accessories shall be supplied without any extra cost. Also, all similar components shall be interchangeable and shall be of the same type and rating for easy maintenance and low spare inventory.

1.03.00 Bidder shall furnish the technical information and data as mentioned elsewhere.

1.04.00 All drawings, schedules and annexure appended to this specification shall form part of the specification, specific reference in this specification and documents to any material by trade name, make, or catalogue number shall be construed as establishing standard of quality and performance and not as limiting competition. The bidder may offer other similar equipment provided it meets the specified standard design and performance requirements.

1.05.00 Each section of the LT switchgears / MCCs shall be provided with at least 20% (minimum 1 no.) of spare modules of each type and rating in addition to owner's requirement, if any, as specified elsewhere.

2.00.00 **CODES AND STANDARDS**

2.01.00 All equipment shall, generally, comply with the updated issues of

(a.) Applicable Indian Standards

(b.) Indian Electricity Act.

(c.) Indian electricity rules

2.02.00 Equipment complying with any other authoritative / internationally recognized standards such as IEC, British, U.S.A., German, etc. will also be considered if it ensures performance equivalent or superior to Indian Standards. In such cases the bidder shall clearly indicate the standard adopted and furnish the copy of latest English version of the same along with the bid and bring out the salient features for comparison.

2.03.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as published one month prior to the date of opening of bids. In case of conflict between this specification and those (IS codes, Standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following codes and standards.

IS: 5	Colors for ready-mixed paints and enamels.

IS: 694	PVC insulated cables for working voltages upto and including 1100V.
IS: 722	A.C. Electricity Meters
IS: 1248	Electrical Indicating instruments
IS/IEC: 60947–1	Degree of protection provided by enclosures for low voltage Switchgear and Control gear
IS/IEC: 60947-2	A.C. circuit Breakers
IS: 2551	Danger Notice Plates
IS: 2629	Hot dip galvanising
IS: 2705	Current Transformers
IS/IEC: IEC-60947-4-1	Contactors and motors starter for voltages not exceeding 1000 V AC or 1200 V DC
IS: 3043	Code of practice for earthing.
IS: 3072	Code of practice for installation and maintenance of Switchgear
IS: 3156	Voltage Transformers
IS: 3202	Code of practice for climate proofing of electrical equipment.
IS: 3231	Electrical relays for power system protection.
IS/IEC 60947	Air-Break Switches, air break disconnectors, air break disconnector and fuse combination units for voltages not exceeding 1000V AC or 1200 V DC.
IS/IEC 60947-1 / IEC-60947-1	General Requirements for Switchgear and Control gear for voltages not exceeding 1000 V.
IS: 5082	Wrought Aluminum and Aluminum alloys for electrical purposes.
IS: 6005	Code of practice of phosphating of iron and steel.

IS/IEC 60947-5-1 / IEC-60947-5-1	LV switchgear and Control gear Control current devices and switching element.
IS: 8623 (3 parts) / IEC: 60439	Specification for factory built assemblies of Switchgear & Control gear for voltages upto and including 1000 V AC & 1200 V DC.
IS: 8686	Static Relays
IS: 13703 / IEC: 60269	HRC Cartridge fuses
IS: 10118 (4 parts)	Code of practice for selection, installation and maintenance of switchgear and control gear.
IS: 11171	Specification for dry type transformers.
IEC: 60255	Electrical Relays
IEC: 61850	Communication networks and systems in substations
IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals
IS: 12021	Specification of control transformers for switchgear and Control gear for voltage not exceeding 1000V AC.
IEC: 60947-7-1	Terminal blocks for copper conductors
IS :513 (2008)	Cold Rolled Low Carbon Steel Sheets and Strips

3.00.00 TECHNICAL PARAMETERS

3.01.00 POWER SUPPLY

3.01.01 AC SYSTEM

1)	Voltage	415 V ± 10%,3 Phase, 4 wire, solidly earthed
2)	Frequency	50 Hz +/- 5%
3)	Combined variation (in volts & frequency)	10% absolute sum
4)	Fault Level	45KA(RMS)

3.01.02	**DC SYSTEM**		
	1)	System Voltage	220V/110V DC 2-Wire, Unearthed
	2)	Fault Level	20 KA
3.01.03	**CONTROL SUPPLY VOLTAGE**		
	1)	Trip & closing coil of circuit breaker	220V DC/110V DC
	2)	Spring charging motor	220V DC/110V DC
	3)	MCC control supply	110V AC Neutral solidly earthed
	4)	Space heater & lighting	240V AC Neutral solidly earthed
3.02.00	**CUBICLE DATA**		
	Busbar Rating		
	1)	Continuous Current rating	As per requirement
	2)	Short time rating where	
		a) CB is used as incomer	45KA(RMS) for one sec
		b) Fuse protection is used in Incomer	Prospective current of 45KA(RMS) for the fuse clearing time
	3)	Dynamic Rating where	
		a) CB is used as incomer	105KA(PEAK)
		b) Fuse Protection is used in incomer	Prospective current of 105KA (PEAK) as limited by fuse
	4)	Busbar insulation	
		a) For switchgear	PVC Sleeve insulated
		b) For MCC	PVC Sleeve insulated
		c) ACDB	PVC Sleeve insulated
		d) DCDB	PVC Sleeve insulated
		e) For fuse boards	PVC Sleeve insulated/ epoxy coated
3.03.00	**CIRCUIT BREAKER**		
	1)	Type	Air break spring charged stored energy type
	2)	Operating duty	B-3 MIN-MB-3 MIN-MB
	3)	Symmetrical interrupting	45KA(RMS)
	4)	Short circuit rating	105KA(PEAK)
	5)	Short Circuit Breaking current	

		a) AC Component	45KA(RMS)
		b) DC Component	As per IS:13947
	6)	Short time withstand	45KA(RMS) for one sec
	7)	No of aux. contacts	4 NO + 4 NC for employer use
3.04.00	**METERS**		
	1)	Accuracy class	2.0
	2)	One min. power frequency withstand test voltage	2.0 KV (rms)
3.05.00	**CURRENT TRANSFORMERS**		
	1)	Type	Cast Resin Bar Primary
	2)	Voltage class and frequency	650 V, 50 HZ
	3)	Class of insulation	E or better
	4)	Accuracy class & burden	
		a) For protection	5P20, 5VA PS Class for REF
		b) For metering	class 1.0, 5VA (min)
	5)	Short time withstand	
		a) For CT Associated with circuit breaker	45KA(RMS) for 1 sec
		b) For CT Associated with fuse protected feeders	Prospective current of 45KA(RMS) for the Fuse clearing time
	6)	Dynamic withstand	
		a) For CTs Associated with circuit breaker	105KA(PEAK)
		b) For CT Associated with fuse protected feeders	Prospective current of 105KA(PEAK) as Limited by fuse
3.06.00	**BUSDUCT**		
	1)	Type	Non-Segregated
	2)	One minute power frequency withstand voltage	2.5 kV

	3)	One second short ckt withstand current	45KA(RMS)
	4)	Momentary dynamic current withstan	105KA(PEAK)
3.07.00	**VOLTAGE TRANSFORMERS**		
	1)	Type	Cast Resin
	2)	Voltage Ratio	415 / 110 V for line PT 415/√3 / 110/√3 V for Bus PT
	3)	Method of Construction	Vee Vee
	4)	Accuracy Class	0.5
	5)	Rated Voltage factor	1.1continuous, 1.5 for 30 sec.
	6)	Class of insulation	E or better
	7)	One minute power frequency withstand voltage	2.5 KV
3.08.00	**HRC FUSES**		
	1)	Voltage Class	650 Volts
	2)	Rupturing capacity	80 KA (rms) for AC ckt. 20 KA for DC ckt.
3.09.00	**CONTACTORS**		
		Type	Air break electro magnetic
	2)	Utilising Category	AC3 of IS:13947 for non reversible AC4 of IS:13947 for reversible drives
3.10.00	**RELAYS**		
	1)	Power frequency withstand voltage	2.5KV for 1 sec. or 2.0 KV for 1 min.

3.11.00	**CONTROL TRANSFORMERS**		
	1)	Type	Dry / Cast Resin
	2)	Voltage Ratio	415 / 110 with taps ± 5% in steps of 2.5%
	3)	Class of insulation	Class-B or better
	4)	One minute power frequency withstand voltage	2.5 KV
	5)	Rating	1.5 x Adequate for application.
3.12.00	**LIGHTING TRANSFORMER / WELDING TRANSFORMER (IF APPLICABLE)**		
	1)	Type & Rating	Dry type / 50KVA/100 KVA
	2)	Voltage Ratio	415/415V, +/- 5% taps in steps of 2.5%
	3)	Class of insulation	B or better
	4)	One minute power frequency withstand voltage	2.5 KV
	5)	Enclosure protection	IP-42
3.13.00	**TRANSDUCERS**		
	1)	Current transducers	
		a) Input	0-1 A (CT secondary)
		b) Rated frequency	50HZ
		c) Output	4-20 mA (2 Nos. decoupled)
		d) Over current	Transducer for motor current ammeters shall be capable of withstanding min. 6 times CT sec. current of 1A for a min period of 30 seconds
		e) Accuracy	1.0
	2)	Voltage Transducers	
		a) Input	110 V(VT secondary) ,50 HZ (for AC)/240 V/120 V DC (for DC)
		b) Output	4-20 mA (2 Nos. decoupled)
		c) Accuracy	1.0
3.14.00		MCCB	

	1)	Rated voltage	415V
	2)	Rated insulation level	690V
	3)	Rated ultimate &Service S.C. breaking capacity	45KA
	4)	Rated making capacity	105KA
	5)	Utilization category	A

4.00.00 CONSTRUCTIONAL DETAILS OF SWITCHBOARDS

4.01.00 All Switchboards i.e., 415 V Switchgears, Motor Control Centres (MCCs), AC Distribution Boards (ACDBs), 220 V DC Distribution Boards (DCDBs) , shall be of metal enclosed, indoor, floor-mounted, free-standing type.

4.02.00 All switchboard frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material.

4.03.00 All panel edges and cover / door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. The top covers of the panels should be designed such that they do not permanently bulge/ bend by the weight of maintenance personnel working on it.

4.04.00 The switchboards shall be of bolted design. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cutouts shall be true in shape and devoid of sharp edges.

4.05.00 All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 5X as per IS: 13947. However, the busbar chambers having a degree of protection of IP: 42 are also acceptable where continuous busbar rating is 1600A and above. Provision shall be made in all compartments for providing IP: 5X degree of protection, when circuit - breaker or module trolley has been removed. All cutouts shall be provided with EPDM / Neoprene gaskets.

4.06.00 Provision of louvers on switchboards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating is 1600 A and above.

4.07.00 All switchboards shall be of uniform height not exceeding 2450 mm.

4.08.00 Switchboards shall be easily extendable on both sides by the addition of vertical sections after removing the end covers.

4.09.00 Switchboards shall be supplied with base frames made of structural steel sections, alongwith all necessary mounting hardware required for welding down the base frame to the foundation / steel insert plates. The base frame height shall be such that floor finishing (50 mm thick) to be done by Contractor after erection of the switchboards does not obstruct the movement of doors, covers, withdrawable modules etc.

4.10.00 All switchboards shall be divided into distinct vertical sections (panels), each comprising of the following compartments:

(a.) BUSBAR COMPARTMENT

A completely enclosed bus bar compartment shall be provided for the horizontal and vertical busbars. Bolted covers shall be provided for access to horizontal and vertical busbars and all joints for repair and maintenance, which shall be feasible without disturbing any feeder compartment. Auxiliary and power busbars shall be in separate compartments.

(b.) SWITCHGEAR / FEEDER COMPARTMENT

All equipment associated with an incomer or outgoing feeder shall be housed in a separate compartment of the vertical section. Two-tier breaker arrangement in a vertical section shall be offered for outgoing breaker feeders of rating up to 1600A. The design of the vertical section for such an arrangement shall ensure ease of termination of power cables of size & quantity as specified in clause 42.00.00.The compartment shall be sheet steel enclosed on all sides with the withdrawable units in position or removed. Insulating sheet at rear of the compartment is also acceptable. The front of the compartment shall be provided with the hinged single leaf door with captive screws for positive closure.

(c.) CABLE COMPARTMENT OR CABLE ALLEY

A full-height vertical cable alley of minimum 250mm width shall be provided for power and control cables. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations located in cable alley shall be designed to meet the Form IVb Type 7 (as per IEC 60439) for safety purpose. The termination for each module shall have its own integral glanding facility. Wherever cable alleys are not provided for distribution boards, segregated cable boxes for individual feeders shall be provided at the rear for direct termination of cables. For circuit breaker external cable connections, a separately enclosed cable compartment shall also be acceptable. The contractor shall furnish suitable plugs to cover the cable openings in the partition between feeder compartment and cable alley. Cable alley door shall be hinged.

(d.) CONTROL COMPARTMENT

A separate compartment shall be provided for relays and other control devices associated with a circuit breaker.

4.11.00 Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. EPDM / Neoprene gasket shall be provided between the panel sections to avoid ingress of dust into panels.

4.12.00	After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose. Wherever two breaker compartments are provided in the same vertical section insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.
4.13.00	All 415V switchgear (circuit-breaker) panels shall be of single-front type. MCCs and DBs shall be of single-front / double-front construction as per the requirements. All single-front switch boards shall be provided with single-leaf, hinged or bolted covers at the rear. The bolts shall be of captive type. The covers shall be provided with "DANGER" labels. All panel doors shall open by 90 deg or more. In case of double-front MCCs, if this cannot be achieved for panels adjacent to a breaker panel, suitable dummy panel shall be provided by the Bidder wherever necessary.
4.14.00	All ACDBs, DCDBs and other DBs shall be of fixed module type. All 415V circuit-breaker modules and contactor controlled motor modules shall be of fully draw out type having distinct 'Service' and 'Test' positions. The equipment pertaining to a draw out type incomer or feeder module shall be mounted on a fully withdrawable chassis which can be drawn out without having to unscrew any wire or cable connection. Suitable arrangement with cradle/ rollers, guides along with tool/lever operated racking in/out mechanism shall be provided for smooth and effortless movement of the chassis. For modules of size more than half the panel height, double guides shall be provided for smooth removal or insertion of module. All identical module chassis of same size shall be fully interchangeable without having to carryout any modifications.
4.15.00	All disconnecting contacts for power and control circuits of drawout modules shall be of robust and proven design, fully self aligning and spring-loaded. Both fixed and moving contacts shall be silver-plated and replaceable. The spring-loaded power and control drawout contacts shall be on withdrawable chassis and the same on fixed portion shall not be accepted. Detachable plug and socket type control terminals shall also be acceptable.
4.16.00	Individual opening in the vertical bus enclosure shall permit the entry of moving contacts from the drawout modules into vertical droppers.
4.17.00	As indicated in schematic drawings of DDC / PLC controlled modules, contractor shall supply & mount two (2) coupling relays in the corresponding modules.
4.18.00	All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to employer's approval. The Contractor shall submit dimensional drawings showing complete internal details of busbars and module components, for each type and rating for approval of Employer.
4.19.00	Employer reserves the right to alter the cable entries, if required during detailed engineering, without any additional commercial implication.
4.20.00	Each switchboard shall be provided with undrilled, removable type gland plate, which shall cover the entire cable alley. Bidder shall ensure that sufficient cable

	glanding space is available for all the cables coming in a particular section through gland plate. For all single core cables, gland plate shall be of non-magnetic material. The gland plate shall preferably be provided in two distinct parts for the easy of terminating addition cables in future. The gland plate shall be provided with gasket to ensure enclosure protection. Recommended drilling chart of gland plates for all power and control cables in the vertical panels shall be indicated by the Contractor in the respective G.A. drawings of the boards.
4.21.00	The Bidder shall consider layout of panels in a switchboard consisting of various feeder modules in a straight line, unless specified otherwise. The actual composition and disposition of various modules in a switchboard shall be finalised during detailed engineering. The switchboards fed from outdoor transformers of rating more then 1MVA and above shall preferably be connected through busducts. Busduct connections wherever applicable shall be preferably in a straight line alignment. The centre line of the busduct will be finalized during detailed engineering. Adopter panels and dummy panels shall be provided wherever required.
4.22.00	**CLEARANCES**
	The minimum clearance in air between phases and between phases and earth for the entire run of horizontal and vertical busbars and bus-link connections at circuit-breaker shall be 25 mm. For all other components, the clearance between "two live parts", "a live part and an earthed part", shall be atleast ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal and vertical busbars the clearances specified above should be maintained even when the busbars are sleeved or insulated. All connections from the busbars upto switch / fuses shall be fully shrouded / insulated and securely bolted to minimize the risk of phase to phase and phase to earth short circuits.
5.00.00	**CONSTRUCTIONAL DETAILS OF AC & DC FUSE BOARDS**
5.01.00	All fuse boards shall be metal enclosed, fixed type, non-compartmentalized construction, suitable for indoor/ outdoor mounting on wall or steel structure.
5.02.00	The fuse board frame shall be fabricated using suitable mild steel structures or pressed and shaped cold rolled sheet steel of thickness not less than 2.0 mm. The frames shall be enclosed by cold rolled sheet steel of thickness not less than 1.6 mm.
5.03.00	The fuse boards shall be provided with doors on the front. The doors shall preferably be in two halves with hinges at the extreme ends and locking facility at the centre.
5.04.00	Suitable EPDM/Neoprene gaskets shall be provided to make fuse boards completely dust and vermin-proof with a degree of protection of IP-52 for indoor and IP-54 for outdoor application, as per IS: 13947.
5.05.00	Each DC fuse board shall comprise of the following : (a.) 1 no. 63 A switch as incomer (b.) 100 A fully insulated (PVC sleeved or epoxy coated) busbars. (c.) 8 nos. 16A outgoing Fuse feeders.

	(d.) 1 no. auxiliary contactor for supply monitoring.
	(e.) 1 no. indicating lamp with resistor and blue coloured lens.
5.06.00	Each AC fuse board shall comprise of the following :
	(a.) 1 no. 63A TPN switch as incomer.
	(b.) 100 A, 3-phase, 4-wire, fully insulated (PVC sleeved or epoxy coated) busbars.
	(c.) 9 nos. 16 A single phase switch fuse units and 3 nos. 16 A TPN switch fuse units as outgoing feeders or alternatively 16 amps MCCB can be provided.
	(d.) 3 nos. indicating lamps with resistors and coloured lenses (R, Y, B) for incoming supply monitoring.
5.07.00	The fuses shall be mounted in an insulating fuse carrier and it shall be possible to replace the outgoing feeder fuses without disturbing the other feeders. The handle of incoming switch shall be mounted on the door of the fuse board, with padlocking facility in both 'ON' and 'OFF' positions. The outgoing feeder switches shall preferably be of rotary type.
5.08.00	Cable entry facilities shall be provided at top / bottom with removable gland plates of suitable thickness. All incoming and outgoing cables shall be terminated on suitable terminal blocks.
6.00.00	**POWER BUSBARS AND INSULATORS**
	All 415 V Switchboards, MCCs and ACDBs shall be provided with three phase and neutral busbars. Two separate sets of vertical busbars shall be provided in each panel of double front MCCs. Interleaving arrangement for busbars shall be adopted for switchboards with a rating of more than 1600A. DCDBs shall be provided with two (2) busbars. Entire busbar system shall be insulated with PVC sleeves.
6.01.00	All busbars and jumper connections shall be of high conductivity aluminum alloy / copper of adequate size.
6.02.00	The cross-section of the busbars shall be uniform throughout the length of switchboard section and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral busbar short circuit strength shall be same as main busbars.
6.03.00	All busbars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength sheet moulded compound or equivalent type polyester fiber glass moulded insulator. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided, anti-tracking barriers shall be provided between the supports. Insulator and barriers of inflammable material such as Hylam shall not be accepted. The busbar insulators shall be supported on the main structure.
6.04.00	All busbar joints shall be provided with high tensile steel bolts, belleville / spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated busbar joints shall be thoroughly cleaned at the jointed locations and suitable contact grease shall be applied just before making a joint. All bolts shall be tightened

by torque spanner to the recommended value. The overlap of the busbars at each joint surface shall be such that the length of overlap shall be equal to or greater than the width of the busbar. All copper to aluminum joints shall be provided with suitable bimetallic washers.

6.05.00 All busbars shall be colour coded as per IS: 375.

6.06.00 Wherever the busbars are painted with black Matt paint, the same should be suitable for temperature encountered in the switchboard under normal operating conditions.

6.07.00 The Bidder shall furnish calculations establishing the adequacy of bus bar sizes for specified current ratings.

7.00.00 AUXILIARY BUSBARS AND CONTROL TRANSFORMERS

7.01.00 AC CONTROL SUPPLY BUSBAR

Each bus-section of all Switchgears and MCCs shall be provided with two (2) nos. 415V / 110V control transformers. The 110V AC control supply from the control transformers shall be run through the MCC by means of two sets of control supply busbars of electrolytic copper. In case of one transformer failure, whole bus section can be fed through single transformer. The control supply to different modules shall be tapped individually from the control supply busbars.

7.02.00 DC CONTROL SUPPLY BUSBARS

Electrically controlled circuit breaker boards shall be provided with DC control supply busbars. The manually controlled breakers shall also be provided with such busbars in case relays are provided. Each section of the switchboard shall be provided with a DC supply by the Contractor. The Contractor shall provide suitable terminals, switch-fuse etc. to receive the DC supply and distribute the same through above mentioned control busbars to the required modules of the respective section. The DC control supply bus of one section shall be coupled to the control supply of other section through a switch located in the bus-coupler breaker panel. The DC supply to the bus-coupler breaker may be given from any of the control buses. For emergency switchgear, Contractor shall provide two DC supplies. The contractor shall provide suitable diodes to derive the control supply through diode auctioneering from the above two supplies.

7.03.00 SPACE HEATER BUSBARS

Panel and motor space heaters shall be fed from separate AC auxiliary busbars running throughout the switchboard. The supply for these busbars shall be tapped from incomer, before the isolating switch/ circuit breaker. Incoming circuit to space-heater bus shall have an isolating switch, HRC fuse and neutral link of suitable rating. Suitable terminals shall also be provided to facilitate energisation of space-heater bus from outside during long shutdowns of unit / switch-board.

7.04.00 CONTROL TRANSFORMERS

The control transformers shall be 415 V/110 V with neutral point-earthed, of insulation class 'B' or better. The sizing of Control transformers shall be carried out by Bidder considering the actual load of power contactors, auxiliary contactors, indicating lamps and other equipment in the module circuit. An additional load of 15

	watts should also be considered for each module, for remote auxiliary relays and lamps to be connected in the control circuit of modules. Bidder shall also ensure that control transformers are adequately designed for meeting the momentary loading requirements & the voltage drop during this condition shall not be more than 5%.
8.00.00	**EARTH BUS AND EARTHING**
8.01.00	A galvanized steel / Copper / Aluminium earth bus shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded / bolted to the framework of each panel and breaker earthing contact bar. Vertical earth bus shall be provided in each vertical section which shall in turn be bolted / welded to main horizontal earth bus.
8.02.00	The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current to earth, as indicated in "Technical Parameters", without exceeding the allowable temperature rise.
8.03.00	Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Contractor's earthing conductors. The horizontal earth bus shall project out of the switchboard ends and shall have predrilled holes for this connection. All joint splices to earth bus shall be made through atleast two bolts, and taps by proper lug and bolt connection.
8.04.00	All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosure framework and truck shall be maintained even after painting.
8.05.00	The carriage and breaker frame shall get earthed while being inserted in the panel and positive earthing of the breaker frame shall be maintained in all positions, i.e. SERVICE & ISOLATED, as well as throughout the intermediate travel.
8.06.00	Each module frame shall get engaged to the vertical earth bus before the disconnecting contacts on the module are engaged to the vertical busbars.
8.07.00	All metallic cases of relays, instruments and other panel-mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. All the equipment mounted on the door shall be earthed through flexible wire/braids. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors, soldering is not acceptable. Looping of earth connections, which would result in loss of earth connections to other devices, when a device is removed, is not acceptable. However, looping of earth connections between equipment to provide alternative paths to earth bus is acceptable.
8.08.00	VT and CT secondary neutral point earthing shall be at one place only, i.e. on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.
8.09.00	All hinged doors having potential carrying equipment mounted on it shall be earthed by flexible wire/ braid. For doors not having potential carrying equipment mounted on it, earth continuity through scraping hinges/ hinge pins of proven design may also acceptable. The Contractor shall establish earth continuity at site also.

9.00.00	**CIRCUIT BREAKERS**
9.01.00	Circuit breakers shall be three pole, air break, horizontal draw out type, and shall have fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified parameters of continuous current rating and fault making / breaking capacity only after provision of cooling fans or special device shall not be acceptable.
9.02.00	Circuit breakers along with its operating mechanism shall be provided with suitable arrangement for easy withdrawal. Suitable guides shall be provided to minimise misalignment of the breaker.
9.03.00	There shall be "SERVICE", "TEST" and "FULLY WITHDRAWN" positions for the breakers. In "Test" position the circuit breaker shall be capable of being tested for operation without energising the power circuits i.e. the power contacts shall be disconnected, while the control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the "SERVICE", "TEST" or "FULLLY WITHDRAWN" position. It shall be possible to close the door in "Test" position.
9.04.00	All circuit breakers shall be provided with "4 NO" and "4NC" potential free auxiliary contacts. These contacts shall be in addition to those required, for internal mechanism of the breaker and should be directly operated from breaker operating mechanism. In case the manufacturer does not have a proven arrangement for providing the required number of circuit breaker auxiliary contacts on the fixed portion of the cubicle, necessary electrically reset latched relays shall be provided complete with all wiring in series with service position limit switch contacts, for multiplying the circuit breaker mounted auxiliary contacts and provide 4 NO and 4 NC contacts. Separate limit switches, each having required numbers of contacts shall be provided in both "SERVICE" and "TEST" position of the breaker. All contacts shall be rated for making, continuously carrying and breaking 10 Amp at 240 V AC and 1 Amp (Inductive) at 240 V DC respectively.
9.05.00	Suitable mechanical indications shall be provided on all circuit breakers to show "OPEN", "CLOSE", "SERVICE ", "TEST" AND "SPRING CHARGED" positions.
9.06.00	Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half a cycle of rated frequency.
9.07.00	All circuit breakers shall be provided with the following interlocks :
9.07.01	Movement of a circuit breaker between "SERVICE" and "TEST" position shall not be possible unless it is in open position. Attempted withdrawal of a closed circuit breaker shall preferably not trip the circuit breaker. In case the offered circuit breaker trips on attempted withdrawal as a standard interlock, it shall be ensured that sufficient contact exists between the fixed and draw out contact at the time of breaker trip so that no arcing takes place even with the breaker carrying its full rated current.

9.07.02	Closing of a circuit breaker shall not be possible unless it is in "SERVICE" position, "TEST" position or in "FULLY WITHDRAWN" position.
9.07.03	Circuit-breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage, to cover the stationary isolated contacts when the breaker is withdrawn. It shall however be possible to open the shutters intentionally against pressure for testing purposes.
9.07.04	A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.
9.07.05	Circuit breakers shall be provided with coded key / electrical interlocking devices, as per requirements.
9.08.00	Circuit breaker shall be provided with anti-pumping feature (soft) and trip free feature, even if mechanical anti-pumping feature is provided.
9.09.00	Mechanical tripping shall be possible by means of front mounted Red "trip" push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.
9.10.00	Complete shrouding / segregation shall be provided between incoming and outgoing bus links of breakers. In case of bus coupler breaker panels the busbar connection to and from the breaker terminals shall be segregated such that each connection can be approached and maintained independently with the other bus section live. Dummy panels if required to achieve the above feature shall be included in the Bidder's scope of supply.
9.11.00	Circuit breaker shall be provided with Power operated mechanism as follows.

1.	Power operated mechanism shall be provided with a universal motor suitable for operation on 220 V DC / 110 DC Control supply, with voltage variation from 90% to 110% of rated voltage. Motor insulation shall be class "E" or better.
2.	The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring at minimum available control voltage.
3.	Once the closing springs are discharged, after one closing operation of circuit breaker, it shall automatically initiate recharging of the spring.
4.	The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.
5.	Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.
6.	All circuit breakers shall be provided with closing and trip coils. The closing coil shall operate correctly at all values of voltage from 85% to 110% of rated voltage. The trip coil shall operate satisfactorily at all values of voltage

	from 70% to 110% of rated voltage
7.	Provision for mechanical closing of the breaker only in "Test" and "WITHDRAWN" positions shall be made. Alternately, the mechanical closing facility shall be normally made inaccessible; accessibility being rendered only after deliberate removal of shrouds.

Note: The circuit breakers for DC applications shall have manually operated mechanism of spring charged, stored energy type. The closing operation of the circuit breaker shall charge the tripping spring. Necessary interlocks shall be provided to inhibit closing of the circuit breaker unless the closing spring is fully charged.

9.12.00 TELESCOPIC TROLLEY

Telescopic trolley or suitable arrangement shall be provided for maintenance of circuit-breaker module in a cubicle. The trolley shall be such that the top most breaker module can be withdrawn on the trolley and can be lowered for maintenance purpose. The telescopic trolley shall be such that all type, size and rating of breaker can be withdrawn /inserted of particular switchgear. The quantity of telescopic trolleys to be supplied shall be adequate for the number of switchgears / switchgear rooms.

10.00.00 AIR BREAK SWITCHES

10.01.00 Air break switches shall be of heavy duty, single throw, group operated, load break, fault make type when associated with fuses. All switches for motor circuits shall be of utilisation category AC-23A with 1NO +1NC auxiliary contact, which shall be wired to the control circuit as shown in the schematic drawings. All switches for other outgoing feeders shall be of utilization category AC-22A. All switches for DC circuits shall be suitable for 220 V DC and shall be of DC-22 utilisation category.

10.02.00 Continuous current rating of the switches for various feeders shall be selected from the 'Module Selection tables' attached at the end of this subsection.

10.03.00 The combination of switch-fuse unit would be preferred. However, if separate switch and fuses are provided, switch shall be located before fuses.

10.04.00 The main switches shall be operable from outside the module door. The switch handle shall clearly indicate the position of switch. Switch operating handles shall be provided with padlocking facilities. However, incomer switches of switchboards shall be provided with padlocking facility in both 'ON' and 'OFF' positions.

10.05.00 Interlocks shall be provided such that the cubicle door will not open when the switch is in closed position and the switch will close only when the door is closed.

10.06.00 Switches and fuses for AC/DC control supply and heater supply wherever required, shall be mounted inside the cubicles. Toggle switch is not acceptable.

10.07.00 Even if a single phase feeder is asked, Bidder shall provide TPN switch, fuse-bases and cable/ link connections between switch/fuse and vertical busbars for all the three

phases, so that changing from single phase feeder to three phase feeder is possible without any modification other than inserting fuses at site.

11.00.00 MCCB

11.01.00 MCCB shall be fixed type/part of withdrawable feeder module as per specification, three pole, air break type having trip free mechanism with quick make and quick break type contacts. MCCB shall have current limiting feature. MCCB of identical ratings shall be physically and electrically interchangeable. MCCB shall be provided with 1 NO and 1NC auxiliary contacts.

11.02.00 MCCB shall be provided with Microprocessor based inbuilt front adjustable releases (overload & short circuit) and shall have adjustable earth fault protection unit also. The protection settings shall have suitable range to achieve the required time & current settings. LED indications shall also be provided for faults, MCCB status(on/off etc).

11.03.00 MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit rating. Extended cable terminal arrangement for higher size cable may also be offered. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door can not be opened unless the MCCB is in OFF position. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked. The MCCBs being offered shall have common/interchangeable accessories for all ratings like aux. switch ,shunt trip, alarm switch etc. The MCCBs shall have the current discrimination up to full short circuit capacity and shall be selected as per manufacturers discrimination table.

12.00.00 CONTROL AND SELECTOR SWITCHES

12.01.00 Control and selector switches shall be of heavy duty, rotary type with escutcheon plates clearly marked to show the positions. The control & selector switches should be as per IS 13947 Part V section 1. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred.

12.02.00 Ammeter and voltmeter selector switches shall have four stay put positions with adequate number of contacts for 3-phase 4-wire system. These shall have oval handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries.

12.03.00 Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.

12.04.00 The contact ratings shall be at least the following :

1.	Make and carry, continuously, 10 A at 240 V DC and 110 V AC
2.	Breaking current at 240 V DC, 1 A (inductive)
3.	Breaking current at 110 V AC and 0.3 lagging p.f., 5A

13.00.00	**CONTACTORS**
13.01.00	Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty as per IS: 13947 Part-4 Section- 1.
13.02.00	Contactors shall be double-break, non-gravity type and their main contacts shall be silver faced.
13.03.00	Direct-on-line contactors shall be of utilization category AC3. Reversing starters shall comprise of Forward and Reverse contactors mechanically and electrically interlocked with each other. These contactors shall be of utilization category AC4. DC contactors shall be of DC3 utilization category. For CHP conveyor motors, minimum rating of power contactors shall be 240% of full load current of the motors. For other drives, minimum rating of power contactors shall be 160% of full load current of motor.
13.04.00	The number of normally open (NO) and normally closed (NC) auxiliary contacts of a contactor shall be as per requirement shown in the respective module drawings. It shall, however, be not less than 2NO+2NC.
13.05.00	Operating coil of contactors shall be of 110 V AC unless otherwise specified elsewhere. The contactor shall operate satisfactorily between 85% and 110% of the rated voltage. The contactor shall not drop out at 70% of the rated voltage but shall definitely drop out at 20% of the rated voltage.
13.06.00	Contactors for DC drives shall have a coil voltage of 240 V DC. DC operated contactor coil shall have an economy resistor and shall be suitable for satisfactory continuous operation at 85% to 110% of rated voltage.
14.00.00	**FUSES**
14.01.00	All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC circuits shall be rated for 80kA rms (prospective) breaking capacity at 415V AC and for DC circuits, 20kA rms breaking capacity at 220V DC.
14.02.00	Fuse shall have visible operation indicators. Insulating barriers shall be provided between individual power fuses.
14.03.00	Fuse shall be mounted on insulated fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchboard.
14.04.00	Fuse ratings for various feeders shall be selected by the Bidder from the 'Module Selection Tables' attached at the end of this subsection. However, the fuse ratings for motor feeders given in the 'Motor Module Selection Table' are indicative only, and the same shall be coordinated by the Bidder to achieve class-II protection coordination and also to match the motor characteristics. Switch rating shall in no case be less than the fuse rating.
14.05.00	The Neutral links shall be mounted on fuse carriers which shall be mounted on fuse bases.

15.00.00	**INSTRUMENT TRANSFORMERS**
15.01.00	All current and voltage transformers shall be completely encapsulated, cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the specified ambient temperature. The class of insulation shall be 'E' or better.
15.02.00	All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum RMS short circuit breaking and peak making current ratings of the associated switchgear.
15.03.00	All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block where star point formation and earthing shall be done.
15.04.00	Current transformers may be multi or single-core type. All voltage transformers shall be single phase type.
15.05.00	The bus VTs shall be housed in a separate compartment. All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides.
15.06.00	All CTs shall be provided with supports independent of busbar / busbar supports.
15.07.00	The CTs shall be located in such a way that they can be easily approached for maintenance without necessitating shut down of adjacent feeders.
16.00.00	**NUMERICAL RELAYS**
16.01.00	All relays in protective circuits shall be flush mounted on panel front with connections from the inside. The protective relays shall be communicable numerical relays. These numerical relays shall be of types as proven for the application and shall be subject to Employer's approval. Numerical relays shall have appropriate setting ranges, accuracy, resetting ratio and other characteristics to provide required sensitivity. All equipments shall have necessary protections as detailed in the standard scheme drawings.
16.02.00	The circuit breaker will normally be controlled from remote control panels (PLC) through closing and shunt trip coils. The Local control console of the relay flush mounted on the switchgear would normally be used only for testing of circuit breaker in isolated position, and for tripping it in an emergency. Provision for closing & tripping of the circuit breaker locally from laptop through serial port shall be possible to facilitate commissioning activities. The basic control scheme of breaker feeders shall be developed as per the schematic logics in the relay. The schematics shall be developed in soft inside the relay. Numerical relays shall be interfaced with PLC appropriately for closing / opening operations.
16.03.00	The numerical relay shall be capable of measuring and storing values of a wide range of quantities, events, faults and disturbance recordings. The alarm / status of each of protection function and trip operation shall be communicated to PLC. The numerical relays shall have built in feature / hardware interface to provide such inputs to PLC for analog / digital values. All the numerical relays shall have communications on two ports; local front port communication to laptop and a rear port on IEC 61850 to communicate with the data concentrator through LAN.

16.04.00	All relays and timers shall be rated for control supply voltage as mentioned elsewhere under parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used.
16.05.00	The protective relays shall have at least 10 Nos. programmable potential free contacts. Programmable Auxiliary relays shall have contacts as required.
16.06.00	Failure of a control or auxiliary supply and deenergisation of a relay shall not initiate any circuit breaker /contactor operation. All relay digital output contacts shall withstand a minimum test voltage of 2kV AC rms for one minute.
16.07.00	All the numerical relays shall have adequate processor memory for implementing the programmable scheme logic required for the realization of the protection / control schemes, in addition to the built in protection algorithms.
16.08.00	Relays shall be suitable for electrical measurement including voltage, current, power (active/reactive) and energy parameters.
16.09.00	Relays shall have separate output for individual functionality and the master trip shall be software configurable in case of multi output relays. Relays shall have event recording feature, recording of abnormalities and operating parameters with time stamping
16.10.00	Preferably comprehensive single numerical relay shall have provision of both current and voltage inputs. The current operated relay shall have provision for 4 sets of CT inputs, 3 nos. for phase fault & 1 CT input for earth fault. Relay shall be suitable for both residually connected CT input as well as CBCT input. The voltage-operated relay shall have provision for 3 PT inputs. Relays shall be suitable for CT secondary current of 1A / 5A selectable at site. Relays used in incomers and bus couplers shall have provision of two sets of voltage signal inputs for the purpose of synchronization.
16.11.00	All CT & PT terminals shall be provided as fixed type terminals on the relay to avoid any hazard due to loose connection leading to CT opening or any other loose connection. In no circumstances Plug In type connectors shall be used for CT / PT connections. Vendor to ensure the same for all protective relay models offered.
16.12.00	All numerical relay shall have key pad / keys to allow relay settings from relay front. All hand reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable. Manual resetting shall be possible from remote.
16.13.00	Relays shall have suitable output contact for breaker failure protection.
16.14.00	Relays shall have self diagnostic feature with self check for power failure, programmable routines, memory and main CPU failures.
16.15.00	Relays shall have at least two sets or groups of two different sets of adaptable settings. Relays shall have multiple IEC / ANSI programmable characteristics. Relays shall have self reset auxiliary contacts of programmable type.

16.16.00	Design of the relay must be immune to any kind of electromagnetic interference. Vendor to submit all related type test reports for the offered model along with the offer.
16.17.00	Relay shall be immune to capacitance effect due to long length of connected control cables. Any external hardware, if required for avoiding mal operation of the relay due to cable capacitance shall be included as a standard feature.
16.18.00	All I/Os shall have galvanic isolation. Analog inputs shall be protected against switching surges, harmonics etc.
16.19.00	Numerical relays shall have two level password protections, one for read only and other for authorization for modifying the setting etc.
16.20.00	Time clock synchronization feature shall be provided for synchronization of clocks of numerical relay and metering LAN with data concentrator time clock. Required hardware and software interface to receive GPS/Time signal to achieve time synchronization shall be supplied by the vendor. The resolution of time synchronization shall be +/- 1.0 millisecond or better throughout the entire system.
16.21.00	Relays shall be suitable to accept both AC & DC supplies of 220V/110 V with tolerance of 70 % to 120 % of rated voltage & shall be finalized during detailed engineering.
17.00.00	**OTHER PROTECTIONS AND CONTROL FUNCTIONS IN THE RELAYS**
17.01.00	For control from PLC control commands shall be hardwired to the numerical relays. Preferably, no separate coupling relays shall be provided.
17.02.00	Trip circuit supervision shall be provided for all feeders to monitor the circuit breaker trip circuit both in pre trip and post trip conditions.
17.03.00	Schematics requiring auxiliary relays /timers for protection function shall be a part of numerical relay. The number of auxiliary relay and timer function for protection function shall be as required. Auxiliary relays for interlocking purpose shall be of self reset type.
17.04.00	Bus no volt condition shall be configured to a output contact of the relay of all incomers for suitably interfacing with PLC. All important signals like breaker status, protection trip (86), etc shall be configured and hardwired for feedback / display in PLC.
17.05.00	Timer functions shall be programmable for on/off delays.
17.06.00	The numerical relay shall be able to provide supervisory functions such as trip circuit monitoring, circuit breaker state monitoring, PT and CT supervisions and recording facilities with Post fault analysis.
17.07.00	The numerical processor shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery back up for real time clock in the event of power supply failure shall be provided.

17.08.00	100 time tagged events /records should be able to store with time stamping Last 5 faults storage including the indication, protection operated , fault location relay and operating time, currents, voltage and time.
17.09.00	Diagnostics Automatic testing, power on diagnostics with continuous monitoring to ensure high degree of reliability shall be shall be provided. The results of the self reset functions shall be stored in battery back memory. Test features such as examination of input quantities, status of digital inputs and relay outputs shall be shall be available on the user interface.
17.10.00	The alarm/status of each individual protection function and trip operation shall be communicated to PLC.
17.11.00	Sequence of events shall have 1 ms resolution at device level.
17.12.00	Measurement accuracy shall be 1 % for RMS Current and voltage (20-120% of rated value).
17.13.00	It shall be possible to carryout open / close operation of breakers from a laptop by interfacing from the relay front port during initial commissioning.
17.14.00	Incomers and motor modules shall have 4-20 mA analog output (current signal) for display in PLC. This may be provided as analog output from the numerical relay or using a suitable CT & current transducer. 4-20 mA analog signal shall be provided for display of each bus voltage in PLC.
17.15.00	At least two licensed copies of necessary software for numerical relay configuration / setting / disturbance analysis and other utilities shall be supplied. Numerical relay configuration for all relays being supplied under the package shall be carried out in line with the approved schematics and shall be submitted for owner's approval. Setting calculations and relay settings configured in relay software for all relays shall be submitted for owner's approval. Approved relay configuration / settings shall be loaded in all the relays prior to dispatch to site.
18.00.00	**INDICATING INSTRUMENTS**
18.01.00	All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96mm square size with 90 degree linear scale and shall have an accuracy class of 1.0 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.
18.02.00	All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment without removing or dismantling the instruments.
18.03.00	All instruments shall have white dials with black numerals & lettering. Black knife edge pointer shall be provided for meters.
18.04.00	Ammeters provided for motor feeders (for motors of rating ≥ 30kW & < 110kW) shall have a compressed scale at the upper current region to cover the starting current upto 6.0 times the CT primary current.

18.05.00	All motor feeders of rating ≥ 30 kW and < 110 kW and all motors of Dust Suppression System shall be provided with Multifunction Digital Energy Meter with communication facility to display the current, voltage, power factor, power energy related data locally as well as communicate these for remote metering/audit/analysis purposes. These meters shall The technical specification for Digital indicating energy meter shall be as follows: a) Input Voltage:110VAC / 220V/110 V DC b) Input Current:1A c) Size:96X96 SQ.MM d) Power & Energy Accuracy: 1.0 e) Mounting: Flush mounting f) Type: True RMS 3-PHASE V,I, kW,PF & kWH indication g) 4 Digit, seven segment LED display/LCD display, with floating decimal h) Communication: In built RS 485 bus port i) Operating Frequency: 45 HZ-65HZ j) Dielectric Test: 2KV RMS for 1 minute k) Over Current: 10 times for 3 sec. l) Aux supply: 90V-300V AC/DC m) Compliance: EMC/EMI n) Field programmable CT ratio o) Analog Current and Energy Output (4-20 mA)
19.00.00	**PUSH BUTTONS**
19.01.00	Push-buttons shall be of spring return, push-to-actuate type. Their contacts shall be rated to make, continuously carry and break 10 A at 110 V AC and 1 A (inductive) at 240 V DC.
19.02.00	All push buttons shall have two (2) normally open and two (2) normally closed contact, unless specified otherwise. The contact faces shall be of silver alloy.
19.03.00	All push-buttons shall be provided with integral escutcheon plates marked with its function.
19.04.00	The color of the button shall as follows : Green for motor START, breaker CLOSE , valve/ damper OPEN commands.

	Red for motor trip, breaker open, valve / damper close commands.
	Black for all annunciation functions, overload reset and miscellaneous commands including reverse for clinker grinder etc.
19.05.00	All push buttons on panels shall be located in such a way that Red push button shall always be to the left of Green push button. In case of clinker grinder etc. the push buttons would be black - red-green from lift to right.
19.06.00	All emergency push buttons shall have mushroom knobs.
20.00.00	**INDICATING LAMPS**
20.01.00	Indicating lamps shall be of CLUSTER LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary.
20.02.00	Lamps shall have translucent lamp-covers of the following colours, as warranted by the application :
	Red for motor ON, valve / damper OPEN, breaker CLOSE.
	Green for motor OFF , valve / damper CLOSE, breaker OPEN.
	White for motor AUTO TRIP.
	Blue for all healthy conditions (e.g. control supply, and also for SPRING CHARGED").
	Amber for all Alarm Conditions (e.g. overload). Also for "SERVICE" and "TEST" position indications.
20.03.00	Bulbs and lamp covers shall be easily replaceable from the front of the cubicle. The method of mounting indicating lamp fittings on panels shall prevent their rotation under the action of lamp removal or replacements, reliance upon the tightness of ring nut for the purpose is not sufficient.
20.04.00	Indicating lamps should be located just above the associated push-button / control switches. Red lamps shall invariably be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along the centre line of control switch / push button pair. Blue and Amber should normally be located above the Red and Green lamps.
20.05.00	When associated with push-buttons, red lamps shall be directly above the green push-button and green lamp shall be directly above the red push button.
20.06.00	All indicating lamps shall be suitable for continuous operation at 90% to 110% of their rated voltage.
21.00.00	**SPACE HEATER**
21.01.00	Space heaters shall be provided in the switchboards wherever the manufacturer considers them necessary and recommends their provision for preventing harmful moisture condensation.

21.02.00	The space heaters shall be suitable for continuous operation on 240 V AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary switches and fuses shall be provided.
21.03.00	The circuit for each panel and motor space heater should have an isolating switch, HRC fuse and isolating link. In addition, the space heater circuit of each panel shall also have a thermostat of suitable rating.
22.00.00	**INTERNAL WIRING**
22.01.00	All switchboards shall be supplied completely wired internally upto the terminals, ready to receive external cables.
22.02.00	All intercubicle and interpanel wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided by the Bidder.
22.03.00	All auxiliary wiring shall be carried out with 650V grade, single core stranded copper conductor, colour coded, PVC insulated wires. Conductor size shall be 1.5 mm^2 (min.) for control circuit wiring and 2.5 mm^2 (min) for CT and space heater circuits.
22.04.00	Extra flexible wires shall be used for wiring to devices mounted on moving parts such as hinged doors. The wire bunches from the panel inside to the doors shall be properly sleeved or taped.
22.05.00	All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.
22.06.00	All internal wiring terminations shall be made with solderless crimping type tinned copper lugs which shall firmly grip the conductor or an equally secure method. Similar lugs shall also be provided at both ends of component to component wiring. Insulating sleeves shall be provided over the exposed parts of lugs to the extent possible. Screw-less (spring loaded) / cage clamp type terminal shall also be provided with lugs.
22.07.00	Printed single tube ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The wire identification marking shall be in accordance with IS: 375. Red Ferrules should be provided on trip circuit wiring.
22.08.00	Wiring for equipment, which are to be supplied by the Contractor and for which the Contractor has to provide mounting arrangement in his panels, shall also be provided by the Contractor, upto the terminal blocks.
22.09.00	All connections from vertical busbars for individual modules above 100 A shall be by Copper / Aluminum links only. The cable connections for modules less than 100 A shall be selected in such a way that there will not be any melting / shorting in case of a short circuit inside the module and the cable shall have current rating to carry the let through energy of the corresponding fuses in case of a fault. The insulation of the cable and its cross section shall be decided considering the high ambient temperature within the module. For all modules where use of cable is envisaged by the Contractor specific approval from the Contractor regarding cable details are to be taken. For power wiring colour coded wire insulation / tapes shall be provided.

23.00.00	**CONTROL TERMINAL BLOCKS**
23.01.00	Terminal blocks shall be 650V grade, 10Amps rated, made up of unbreakable polyamide 6.6 grade. The terminals shall be either screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design.
23.02.00	Terminal blocks for CT and VT secondary leads shall be of stud type, made up of unbreakable polyamide 6.6 grade. They shall be provided with links to facilitate testing, isolation star / delta formation and earthing. Terminal blocks for CT secondary shall have the short circuiting facility. The terminals for remote ammeter connection etc. shall also be disconnecting type only. All metal parts shall be of non-ferrous material. Screws shall be captive.
23.03.00	In all circuit breaker panels MCC modules at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks.
23.04.00	All terminal blocks shall be suitable for terminating on each side two (2) nos. stranded copper conductors of size upto 2.5 sq. mm each, or alternatively, the terminal blocks shall have the possibility of double shorting space to facilitate looping. However for PLC terminals shall be suitable for 1.5 mm2 cable.
23.05.00	All terminals shall be numbered for identification and grouped according to the function. Engraved white-in-black labels shall be provided on the terminal blocks.
25.06.00	Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.
25.07.00	Terminal blocks shall be arranged with atleast 100mm clearance between two sets of terminal blocks. The minimum clearance between the first row of terminal blocks and the associated cable gland plate shall be 250 mm.
24.00.00	**POWER CABLE TERMINATION**
24.01.00	Cable termination compartment and arrangement for power cables shall be suitable for heavy duty, 1.1 kV grade, stranded aluminum conductor, PVC/ XLPE insulated, armoured / unarmoured and PVC sheathed cables. The size and type of cable for individual modules shall, preferably, be as indicated in the 'Module Selection Tables'. All necessary cable terminating accessories such as supporting clamps and brackets, hardware etc. for cables shall be provided by the contractor to suit the final cable sizes.
24.02.00	All power cable terminals shall be of stud type and the power cable lugs shall be of tinned copper solderless crimping ring type conforming to IS: 8309. All lugs shall be insulated/ sleeved.
25.00.00	**LOCAL PUSH BUTTON STATIONS**
25.01.00	The local push button stations shall be metal enclosed, suitable for outdoor / indoor mounting on wall or steel structures. The enclosure shall be die-cast aluminum or

cold-rolled sheet steel of at least 1.6 mm thickness. The enclosure shall be provided with a hinged guard at the front, covering full length, to avoid inadvertent operation of push buttons. LPBS shall be powder coated with shade no. RAL: 9002. The minimum thickness of powder coating shall be 50 microns. Support structure for mounting the LPBS shall also be supplied by Contractor.

25.02.00 The local push button stations shall be dust and vermin proof and shall have a degree of protection of IP -55 as per IS : 13947. The DOP shall be IP-65 in case the same are located in dusty areas.

25.03.00 The push button stations shall be suitable for bottom cable entry and shall be provided with removable undrilled gland plates or knockouts. Adequate space shall be available inside the push button station enclosure for terminating external cables directly on pushbutton terminals. Overall size of push button stations shall be subject to Employer's approval.

25.04.00 The push button station shall comprise of a latched type EMERGENCY STOP push button with two (2) NO and two (2) NC contacts.

26.00.00 LOCAL MOTOR STARTERS

26.01.00 Local motor starters shall be suitable for manual switching of 415 V, 3-phase, squirrel cage motors rated upto 5.5 KW. They shall have constructional features similar to those specified for local push button stations.

26.02.00 Each starter shall comprise of :

1.	A 3-pole contactor, mechanically latched type.
2.	Start push button, colored green.
3.	Stop push button, colored red.
4.	Ambient temperature compensated, thermal over load relay with single phasing protection. The continuously variable relay setting range shall be suitable for the motor rating which shall be advised to the Contractor in due course. The relay shall trip the contactor.

26.03.00 The start push button, when pressed, shall preferably remain in depressed position and shall be released along with the contactor when the stop push button is pressed or when thermal overload relay operates.

26.04.00 Local starters shall be suitable for loop-in and loop-out of incoming cable and for one outgoing cable to motor. Final cable sizes and number of lugs required will be intimated to the contractor. Support structure for mounting in local motor starters shall be supplied by the Contractor.

27.00.00 NAME PLATES AND LABELS

27.01.00 All Switchgears, MCCs, Distribution Boards, Fuse boards, all feeders, local push-button stations and local motor starters shall be provided with prominent, engraved

	identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear switchgear also.
27.02.00	All name plates shall be of non-rusting metal or 3-ply Lamicoid, with white engraved lettering on black background. Inscription & lettering sizes shall be subject to Employer's approval.
27.03.00	Suitable stenciled paint mark shall be provided inside the panel/module for identification of all equipment in addition to the plastic sticker labels, if provided. These labels shall be positioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring drawings.
27.04.00	Caution name plate "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end.
28.00.00	**METAL ENCLOSED NON SEGREGATED PHASE BUSDUCT**
28.01.00	Three phase and neutral metal enclosed non segregated phase bus duct assemblies shall be supplied for incoming connections from the transformers to the switch boards and inter connecting sections between switch boards, wherever called for.
28.02.00	The enclosure shall be made of minimum 3 mm thick aluminum alloy. The section of the bus duct shall be rectangular. The design of the bus duct enclosures shall be of sturdy construction such that it will withstand the internal or external forces resulting from the various operating conditions.
28.03.00	The entire bus duct shall be designed for dust, vermin and weather proof construction. A suitable aluminum sheet flange-protection hood shall be provided to cover all outdoor bus duct enclosure joints to facilitate additional protection against rain water ingress. All horizontal runs of busducts shall have a suitable sloped enclosure top to prevent retention of water for both indoor and out door portion of bus ducts. Bus duct enclosure shall have a degree of protection of IP-55.
28.04.00	The inside of the bus enclosure may be treated with black paint to enable efficient heat dissipation. The matt paint used shall be suitable for temperature experienced during continuous loading of the bus conductor. The busduct exterior paint shade shall be RAL 5012. The thickness of finish coat shall be minimum 50 microns (with minimum total DFT of 100 microns).
28.05.00	Flexible expansion joints for the enclosure shall be provided wherever deemed necessary by the Bidder. Necessary bonding shall be provided at the expansion joints if made of insulating materials.
28.06.00	Enclosures shall be provided with flanged ends with drilling dimensions to suit the flanges at the switchgear and transformer terminals. Any adapter boxes required for this purpose are in the Bidder's scope of supply. The prices of such adopter boxes shall be included in the prices of respective switchboards. The flanges shall be provided with gaskets, nuts, bolts, etc. Details of the flanges provided on transformer ends will be furnished to the successful Bidder.
28.07.00	Suitable Inspection covers shall be provided for periodic inspection of insulators. Handle shall be provided on each inspection cover to facilitate easy lifting.

28.08.00	The EPDM / Neoprene gaskets shall be provided so as to satisfy the operating conditions imposed by temperature, weathering, durability etc. Flange gaskets shall be provided at the equipment terminal connections.
28.09.00	Necessary earthing arrangement as applicable shall be provided with clamps to receive 's station earthing bus. All accessories and hardware required for the earthing arrangement shall be provided by the Bidder. This shall be a GI strip of adequate size, continuously running along the bus duct and shall be earthed at both ends. Bus duct enclosures shall be bolted type.
28.10.00	The material of the conductor shall be aluminum. The minimum clearance in air between phase to phase, phase to neutral and phase to earth for the entire run of busduct shall be 25 mm The bus bars shall be rated in accordance with the service conditions and the rated continuous and short time current ratings specified elsewhere in specification.
28.11.00	All steel structures required for bus duct support shall be hot dip galvanised.
28.12.00	Space heaters shall be provided in the busduct wherever the manufacturer considers them necessary and recommends their provision for preventing harmful moisture condensation.
28.13.00	The space heaters shall be suitable for continuous operation on 240 V AC, 50 Hz single phase supply and shall be automatically controlled by thermostats. Necessary wiring upto junction boxes mounted on bus duct and from junction boxes to switch boards shall be provided by the Bidder.
29.00.00	**LIGHTING / WELDING TRANSFORMERS** Each AC Lighting Distribution Board (LDB) shall consist of:- (i) Two (2) Nos. x 100% rated Lighting transformers (415V/415V, delta/star, epoxy insulated. The transformer shall be of 50KVA/100KVA rating for 10/15 nos. outgoing feeder. (ii) TPN SFU on primary and secondary side of the transformer. (iii) 63A TPN SFU as outgoing feeders including 20% spares. (iv) Voltmeter, ammeter with selector switches, indicating lamps. (v) The two incomers (One from Bus-A and One from Bus-B of the MCC) and one bus-coupler for the power supply to each MLDB shall be provided with castle key networks The lighting transformer may, preferably, be located inside the LDB panel itself. Otherwise, the same shall be located by the side of respective LDB. Lighting transformers shall be dry type, natural air cooled with class B insulation or better. Impedance of lighting transformer shall be so selected that the fault level of lighting system shall be reduced to 3 to 5 KA. Lighting transformers shall be tested as per IS: 2026. Off-circuit tap changer with ± 2.5% and ± 5% tapping shall be provided. In case the transformers are not mounted inside the LDB panels, the same shall be housed in a separate 2 mm thick CR sheet steel enclosure with IP-42 degree of protection as per IS : 13947. However, the transformer terminal box shall have IP-52 degree of protection.

30.00.00 PAINTING

All sheet steel work shall be pretreated, in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "Class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, Electrostatic Powder Coating shall be used. Powder should meet requirements of IS 13871 (Powder costing specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the Employer. The paint thickness shall not be less than 50 microns. Finished parts shall be suitably packed and wrapped with protective covering to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

31.00.00 GASKETS

The gaskets, wherever specified, shall be of good quality EPDM / Neoprene with good ageing, compression and oil resistance characteristics suitable for panel applications.

32.00.00 TEMPERATURE –RISE

The temperature rise of the horizontal and vertical busbars and main bus links including all power drawout contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg C with silver plated joints and 40 deg C with all other types of joints over an outside ambient temperature of 50 deg C. The temperature rise of the accessible parts/external enclosures expected to be touched in normal operation shall not exceed 20deg. C. The temperature rise of manual operating means shall not exceed 10deg. C for metallic & 15 deg. C for insulating material. Temperature rise for the busbars shall be carried out at 90% of the rated current. The above temperature rise limits are applicable for busducts also without any current derating.

33.00.00 DERATING OF EQUIPMENTS

The Bidder shall ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per Indian Standards / Specification. Continuous current rating at 50 deg C ambient in no case shall be less than 90% of the normal rating specified.

The Bidder shall indicate clearly the derating factors if any employed for each component and furnish the basis for arriving at these derating factors duly considering the specified current ratings and ambient temperature of 50 deg C.

34.00.00 PROTECTION CO-ORDINATION

It shall be the responsibility of the Contractor to fully coordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers / fuses / motor starters, to provide satisfactory discrimination. Further the various equipment supplied shall meet the requirements of Type II class of Co-ordination as per IS: 8544.

35.00.00 TESTS AND TEST REPORTS

GENERAL

(a.) All equipments to be supplied shall be of type tested design. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

(b.) In case the Contractor is not able to submit report of the type test(s) conducted not earlier than ten years prior to the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost either at third party lab or in presence of client/owners's representative and submit the reports for approval.

(c.) All routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

The following type test certificates on each type & rating of L.T. Switchgear and MCC panel shall be submitted.

1)	Switchgear / MCC panels of each rating		
	a)	Short time withstand test.	
	b)	Temperature rise test.	
	c)	Degree of protection test	
2)	Circuit breaker of each rating		
	a)	Test sequence 1	
		-	Dielectric properties.
		-	Mechanical operation and operational performance capability
		-	Verification of dielectric withstand.
		-	Verification of temperature-rise
	b)	Combined test sequence (With Circuit breakers mounted inside the Switchgear panel)	
		-	Rated short-time withstand current
		-	Rated service short-circuit breaking capacity
		-	Verification of dielectric withstand
		-	Verification of temperature-rise

3)	MCC modules of any three ratings, as selected by the Employer, for class - II protection Co-ordination.
4)	Test for single phasing protection feature on 3 nos. bimetallic thermal overload relay selected by Employer. The relay shall be tested for compliance with manufacturer's printed / declared characteristic curve.

35.01.00 For the following equipment the contractor shall submit the reports of all the type tests as per applicable standards and carried out not earlier than ten years prior to the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In case the Contractor is not able to submit report of the type test(s) conducted not earlier than ten years prior to the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owner's representative and submit the reports for approval.

(a.) NUMERICAL RELAYS

(b.) LIGHTING / WELDING TRANSFORMER

(c.) MCCB

35.02.00 Type test reports for the following tests on the model of the Numerical relays, Ethernet switches shall be submitted for employer's review.

	Test		Specification
1	**Functional requirements**		
	1	Features and logics	IEC61850
	2	Checking of compatibility with co-operating devices	IEC61850
	3	Communication	IEC61850
2	**Mechanical construction requirements**		
	1	General inspection	Manufacturer's document
	2	Inspection of marking and data	IEC 60255-6
	3	Clearances and creepage distances	IEC 60255-5
	4	Degree of protection by enclosure	IEC 60529
3	**Insulation requirements**		
	1	Dielectric test	IEC 60255-5
	2	Impulse voltage test	IEC 60255-5
	3	Insulation resistance measurements	IEC 60255-5
4	**Accuracy requirements**		

	1	Measurement accuracy of characteristic quantity and specified time	IEC 60255-6
	2	Limits of frequency range and frequency dependence	IEC 60255-6
	3	Limits of ambient temperature and ambient temperature dependence	IEC 60255-6
	4	Limits of operative range of auxiliary energizing inputs and auxiliary voltage dependence	IEC 60255-6
5	**Rated burden requirements**		
	1	Measuring circuits	IEC 60255-6
	2	Auxiliary circuits	IEC 60255-6
	3	Signalling inputs	IEC 60255-6
6	**Thermal requirements**		
	1	Temperature rise	IEC 60255-6
	2	Limiting continuous thermal withstand values	IEC 60255-6
	3	Limiting short-time thermal withstand values	IEC 60255-6
7	**Limiting dynamic value requirements**		IEC 60255-6
8	**Power supply requirements**		
	1	Limiting duration of interruptions to dc auxiliary voltage	IEC 60255-11
	2	Limiting value of ripple in dc auxiliary voltage	IEC 60255-11
	3	Limiting value of voltage dips to ac auxiliary voltage	IEC 61000-4-11
	4	Limiting duration of interruptions to ac auxiliary voltage	IEC 61000-4-11
	5	Limiting variations of ac auxiliary voltage	IEC 61000-4-11
9	**Electromagnetic compatibility requirements**		
	1	High frequency disturbance test	IEC 60255-22-1
	2	Electrostatic discharge test	IEC 60255-22-2, 61000-4-2
	3	Radiated, radio-frequency, electromagnetic field immunity test	IEC 60255-22-3, 61000-4-3

	4	Fast transient disturbance test	IEC 60255-22-4, 61000-4-4
	5	Surge immunity test	IEC 60255-22-5, 61000-4-5
	6	Immunity to conducted disturbances, induced by radio-frequency fields	IEC 60255-22-6, 61000-4-6
	7	Power frequency immunity test	IEC 60255-22-7
	8	Conducted and Radiated radio-frequency emission tests	IEC 60255-25, EN55011-CISPR 11
	9	Power frequency magnetic field immunity test	IEC 61000-4-8
	10	**Environmental requirements**	
	1	Dry cold test	IEC 60068-2-1
	2	Dry heat test	IEC 60068-2-2
	3	Storage temperature test	IEC 60068-2-8
	4	Damp heat test, cyclic (12 + 12 hour cycle)	IEC 60068-2-30
	11	**Contact performance requirements**	
	1	Make and carry for dc	IEC 60255-23
	2	Breaking capacity for dc	IEC 60255-23
	3	Make and break ac	IEC 60255-23
	12	**Mechanical performance requirements**	
	1	Durability of relay operation	IEC 60255-6
	2	Durability of plug-in relays	IEC 60255-6
	3	Durability of relay setting controls	IEC 60255-6
	4	Vibration response and endurance test	IEC 60255-21-1
	5	Shock response and withstand test	IEC 60255-21-2
	6	Bump test	IEC 60255-21-2

37.05.00 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.

All routine tests as per the specification and relevant standard IS 8623 shall be carried out. Charges for these shall be deemed to be included in the equipment price

An indicative lists of tests / checks is mentioned as QA chapter . However, the manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

37.06.00 All procedures for type tests shall be approved by Employer before commencement of type tests. However, the following points may be specifically noted.

1)	For temperature rise tests, the connection arrangement between the source and the test equipment shall be such that the temperature gradient in the connection piece of cable at a distance of one meter away from the test equipment shall be restricted to 5 deg C.
2)	Milli Volt drop test shall be done on switching devices before and after the type tests.
3)	Bolt tightness of busbar joints shall be checked with torque wrench before and after short time rating tests on the circuit breaker and MCC panels.

37.07.00 Routine checking to observe compliance to degree of protection, first numeral, on switchboard enclosures and busbar chambers shall be as under:

1) IP -4 X	It shall not be possible to insert a one mm dia. Steel wire into the enclosure from any direction, without using force.
2) IP-5X	It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.

38.00.00 ERECTION / INSTALLATION OF SWITCHBOARDS AND OTHER EQUIPMENTS

38.01.00 Each equipment shall be installed in a neat, workman-like manner so that it is leveled, plumbed, squared and properly aligned and oriented. Tolerances shall be as established in Contractor's drawings or as stipulated by Employer. No equipment shall be permanently fixed down to foundations until the alignment has been checked and found acceptable by the Employer.

38.02.00 Contractor shall furnish all supervision, labour, tools, equipment, rigging materials, bolts, wedges, anchors, etc.., in proper time, required to completely install, test and commission the equipment.

38.03.00 Manufacturer's and Employer's instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment.

38.04.00 Contractor shall move all equipment into the respective rooms through the regular door or openings specifically provided for this purpose. No part of the structure shall be utilised to lift or erect any equipment without prior permission of Engineer.

38.05.00 All switchboards shall be installed in accordance with Indian Standard, IS: 3072, and Employer's instructions.

38.06.00	Switchboard panels shall be installed on concrete floor or supported on steel channel / edge angle in concrete trenches. The Contractor shall provide steel insert plates in the concrete floor and / or steel channels / edge angle on the trenches as applicable. The base frame of switchboards shall be welded to the insert plates by the Contractor. The Contractor shall be required to install and align the panels using suitable metallic shims before welding the base frame. In joining shipping sections of switchboards together, adjacent housing of panel sections or flanged throat sections shall be bolted together after alignment has been completed.
38.07.00	Contractor shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments and relays are supplied separately they shall be mounted only after the associated panels have been erected and aligned. the blocking materials employed for safe transit of instruments and relays shall be removed after ensuring that panels have been completely installed and no further movement of the same would be necessary. Any damage shall be immediately reported to Engineer.
38.08.00	Equipment furnished with finished coats of paint shall be touched up by Contractor if their surface is spoiled or marred during erection / commissioning.
38.09.00	The room and floor finishing work would be done after erection of the panels and the Contractor shall suitably cover up the panels to protect them from injury and marring of finish.
38.10.00	In case of relocation of existing switchgear, complete dismantling, shifting to new location, installation along with necessary civil foundation, inter-panel wiring, testing, commissioning and putting into service of all such switchgears shall be carried out by the contractor in co ordination with the site in charge.
39.00.00	**COMMISSIONING CHECKS / TESTS**
39.01.00	After installation of panels, power and control wiring and connections, Contractor shall perform operational tests on all switchboards, to verify proper operation of switchboards / panels and correctness of all equipment in each and every respect.
39.02.00	The Contractor shall carry out the following commissioning checks, in addition to other checks and tests recommended by the manufacturers.
39.03.00	GENERAL (a.) Check name plate details according to the approved drawings. (b.) Check for physical damage. (c.) Check tightness of all bolted connections, by torque wrench. (d.) Check earth connections. (e.) Check cleanliness. (f.) Check all moving parts for proper lubrication.
39.04.00	Circuit Breakers (a.) Check alignment of breaker truck for free movement.

(b.) Check correct operation of shutters.

(c.) Check control wiring for correctness of connections, continuity And IR values.

(d.) Manual operation of breakers completely assembled.

(e.) Closing /opening operation, manually and electrically.

(f.) Trip free and anti-pumping operation.

(g.) I.R. values of contacts.

(h.) Contact resistance.

(i.) Check on spring charging motor, correct operation of limit switches and time or charging.

(j.) All functional checks

(k.) Breaker closing and tripping time, if required.

39.05.00 Current Transformers

(a.) Visual inspection.

(b.) IR Value

(c.) Ratio check.

(d.) Magnetising current.

(e.) Wiring connection.

(f.) Spare CT cores, if any, to be shorted and earthed

39.06.00 Voltage Transformers

(a.) Visual inspection.

(b.) IR Value

(c.) Ratio check

(d.) Mangnetising current

(e.) Line connection as per connection diagram

39.07.00 Cubicle Wiring

(a.) Check all switch developments

(b.) Each wire shall be traced by continuity tests and it shall be ensured that the wiring is as per relevant drawing. All inter-connections between panels / equipment shall be similarly checked.

(c.) All the wires shall be meggered to earth.

(d.) Functional checking of all control circuit e.g., closing, tripping, control, interlock, supervision and alarm circuit.

39.08.00 Relays

1. Check connections and wiring.

2. Megger
   a) Megger all terminals to body.
   b) Megger AC to DC terminals.
3. Check operating characteristics by secondary injection.
4. Check minimum pick up voltage of DC coils.
5. Check operation of electrical / mechanical targets.
6. Relay settings.
7. Check CT and VT connections with particular reference to their polarities.

39.09.00 Meters

(a.) Visual inspection.

(b.) Megger all insulated partitions.

(c.) Check CT and VT connections with particular reference to their polarities for power type meters.

(d.) Calibration.

40.00.00 AC MODULES DESCRIPTION

40.01.00 Module type DAE (Circuit Breaker Module)

(a.)	One (1)	Triple-pole circuit breaker, complete with all accessories and power operated mechanism, as specified.
(b.)	Three (3)	Current transformers for Protection and metering.
(c.)	One (1)	DC isolating Switch
(d.)	Six (6)	HRC Control fuses.

(e.) Numerical relay for the following:

- Short Circuit Protection
- Earth Fault Protection
- Over Load protection
- Energy Metering
- Current and Voltage metering
- Trip Circuit Supervision
- CB Monitoring
- Synchronizing Check feature

40.02.00 Module Type DAET (Circuit Breaker Incomer From Transformer)

Similar to module type DAE; but with additional PS Class Current transformers for Restricted Earth Fault Protection. The Numerical relay shall have provision for REF protection in addition to the features listed against module type DAE.

40.03.00 Module Type CS (AC Control Supply Module)

(Note: Module type CS will be of non-drawout type)

Two (2)	415/110 V control transformers.	
Four (4)	110V auxiliary relays.	
Two (2)	Earth links.	
Eight (8)	HRC Control fuses.	
Two (2)	Selector switches	

40.04.00 Module Type E/E1/E2 (Switch Fuse Module/MCCB)

(a)	One (1)	Triple pole switch-fuse unit with three pole isolating switch and three / one / two HRC fuses for E/E1/E2 modules, respectively.
(b)	One (1)	Neutral link.

40.05.00 Module Type G1 (VT Module with Under Voltage / No Volt Relay)

(a.)	Three (3)	415/√3 / 110/√3 V single phase voltage transformers, mounted on a common draw-out chassis
(b.)	Three (3)	HRC fuses for VT primary.
(c.)	Three (3)	HRC control fuses.

40.06.00 Module Type H (Isolating Switch Module)

(a)	One (1)	Triple pole load break isolating switch
(b)	One (1)	Neutral link

40.07.00 Module type K1 (Non Reversible Motor Rated Below 30 kW Controlled from MCC)

(a)	One (1)	Triple pole fuse switch unit with three pole load break isolating switch and three HRC fuses.
(b)	One (1)	Triple pole contactor.
(c)	One (1)	Bimetallic thermal overload relay with single phasing preventer.
(d)	Two (2)	Push buttons.
(e)	Three (3)	Indicating lamps with resistors and coloured lenses.
(f)	One (1)	HRC control fuse.
(g)	One (1)	Control link.

40.08.00 **Module Type K11 (Non reversible Motor Rated 30kW to 200kW Controlled from MCC)**

Similar to module type K1 but with the following additions:

One (1) Current transformer for metering.

One (1) Ammeter

One (1) Single-pole switch and fuse for motor space heater.

40.09.00 **Module type DK2 (Non Reversible Motor rated below 30kW Controlled from PLC)**

(a)	One (1)	Triple pole switch fuse unit with three pole load break Isolating switch and three HRC fuses.
(b)	One (1)	Triple pole contactor.
(c)	One (1)	Bimetallic thermal overload relay with single phasing preventor. Modules marked with * (DK2* / PK2*) shall not have this relay.
(d)	Three (3)	Indicating lamps with resistors and coloured lenses.
(e)	One (1)	HRC control fuse.
(f)	One (1)	Control link
(g)	One (1)	Auxiliary contactor
(h)	Two (2)	Coupling relays suitable for 24V DC.

40.10.00 **Module Type DK21 (Non Reversible Motor rated 30kW to up to 110KW controlled from PLC).**

(a) Similar to module type DK2 but with the following additions :

(b) One (1) Current transformer for metering.

(c) One (1) Ammeter (for motors of rating ≥ 30kW & < 110kW)

(d) One (1) Single-pole switch and fuse for motor space heater.

(e) One (1) Digital Energy Meter with Analog output of Current (4-20 mA) (for motors of rating ≥ 30kW & < 110kW and all dust suppression motors)

40.11.00 **Module Type DN1 (Reversible Motor Controlled from PLC)**

(a.)	One (1)	Triple pole fuse switch unit with three pole load break solating switch and three HRC fuses.
(b.)	Two (2)	Triple pole mechanically interlocked, forward / reverse contactors.
(c.)	One (1)	Bimetallic thermal overload relay with single phasing preventor.
(d.)	One (1)	Indicating lamp with resistor and coloured lens.

	(e.)	One (1)	HRC control fuse
	(f.)	One (1)	Control link
	(g.)	One (1)	Auxiliary contactor
	(h.)	Two (2)	Coupling relays suitable for 240V DC.
40.12.00	**Module Type VM (Voltmeter Module)**		
	(a.)	Three (3)	HRC fuses.
	(b.)	One (1)	Voltmeter (0-500 V.)
	(c.)	One (1)	Four position voltmeter selector switch
	(d.)	One (1)	415 V auxiliary contactor with 2 NO + 2 NC contacts.
	(e.)	One (1)	Voltage transducer with output of 4-20mA between R & Y phases
40.13.00	**Module Type DM (Circuit Breaker (DDC /PLC Controlled) Motor Feeder for motor rated 110 KW & above.**		
	(a.)	One (1)	Triple-pole circuit breaker, complete with all accessories and power operated mechanism, as specified.
	(b.)	Three (3)	Current transformers for Protection and metering.
	(c.)	One (1)	DC isolating Switch
	(d.)	Six (6)	HRC Control fuses.
	(e.)	One (1)	Single-pole switch and fuse for motor space heater
	(f)	Numerical relay for the following:	
		Short Circuit Protection (50)	
		Thermal Over Load protection(51I)	
		Earth fault Protection(50N)	
		Negative sequence Protection(46)	
		Restart inhibit protection(49)	
		Locked Rotor Protection	
		Energy Metering	
		Current and Voltage metering	
		Trip Circuit Supervision	
		CB Monitoring	
41.00.00	**DC MODULES DESCRIPTION**		
41.01.00	**Module Type -CH (Incomer from Charger)**		
	(a)	One (1)	Double pole, 250 V DC fuse -switch unit

41.02.00	**Module Type -DB (Incomer from Battery)**		
	(a)	Two (2)	HRC fuses with striker pins and Fuse monitoring relays with contacts for alarm. These fuses shall be mounted in a separate fiber glass / plastic enclosure and located in the battery room.
	(b)	One (1)	DC ammeter with shunt and centre zero. This shall be mounted in the DCDB.
41.03.00	**Module Type - DC**		
	(a)	One (1)	Double pole 250V DC switch / circuit breaker with 2NO+2NC auxiliary contacts.
41.04.00	**Module Type - HD (DC Isolating Switch / Circuit - Breaker Module)**		
	(a)	One (1)	Double pole , 250 V DC switch isolator / circuit breaker
41.05.00	**Module Type-S (DC Metering and Protection Module)**		
	(a)	One (1)	Voltmeter, 0-300V DC
	(b)	One (1)	Three position voltmeter selector switch
	(c)	One (1)	Instantaneous under voltage relay (27) with a setting of 95% of 240V DC. The resetting ratio of relay should not be more than 1.05.
	(d)	One (1)	Instantaneous over voltage relay (59) which shall operate at 110% of 240 V DC. The resetting ratio of relay should not be less than 0.95.
	(e)	One (1)	Earth leakage relay having adjustable pick up range between 3 to 7mA. The relay shall be suitable for 240V / 50V DC and 240V AC auxiliary supply. The relay shall be Alstom type CAEM-21 or equivalent.
	(f)	Two (2)	Indicating lamps with resistors & coloured lenses, one each for 'Earth fault' and 'DC supply failure ' indications.
	(g)	Three (3)	HRC control fuses.
	(h)	One (1)	Neutral link
41.06.00	**Module Type -X (DC Isolating Switch Fuse Module)**		
	(a)	One (1)	Double pole , 250 V DC fuse switch unit with two HRC fuses.
41.07.00	**Module Type DW1 (DC Solenoid Valve Controlled from DDC)**		
	(a)	One (1)	Double pole 250 V DC isolating switch
	(b)	Two (2)	HRC fuses
	(c)	One (1)	Contactor with coil suitable for 240 V DC.
	(d)	One (1)	Auxiliary contactor with coil suitable for 240 V DC

(e) One (1) Coupling relay

(f) One (1) Diode with peak inverse voltage of 440 V.

41.08.00 Module Type Q (Incomer to DC Lighting DB)

(a) One (1) Double pole , 250 V DC switch isolator

(b) One (1) Power Contactor

(c) Two (2) Instantaneous under voltage relays (27) with a setting of 60% of 110V AC.

(d) One (1) Timer having a delay of 0.5 to 3 sec. on pick-up with 2 self reset NO contacts, suitable for 240 Volts DC.

(e) Two (2) Indicating lamps with resistors & coloured lenses, one each for 'On' and 'Off' indications.

(f) Four (4) HRC control fuses

(g) Two (2) Neutral links

42.00.00 SELECTION TABLES

42.01.00 Feeder Module, Other than Motor Selection Table (415 V AC)

No.	Feeder Rating (Amp.)	Switch/MCCB Rating (Amp.)	Fuse Rating (Amp.)	Cable Size (sq. mm)
1.	0-16	16	16	4CX6
2.	17-32	32	32	4CX16
3.	33-45	63	63	$3\frac{1}{2}$CX35
4.	46-63	63	63	$3\frac{1}{2}$CX70
5.	64-125	125	125	$3\frac{1}{2}$CX70
6.	126-160	160	160	3CX150+1-1CX150
7.	161-200	250	200	3CX240+1-1CX150
8.	201-250	250A MCCB		3-1CX300+1-1CX150
9.	251-400	400A MCCB		3-1CX630+1-1CX300
10.	401-630	630A MCCB		3-1CX630+1-1CX300
11.	631-1120 (Breaker)			7-1CX630
12.	1121-1680 (Breaker)			10-1CX630

Note i) The cables of size below 120 sq. mm shall be PVC insulated and those of size above 120 sq. mm shall be XLPE insulated

ii) All cables shall be of aluminium conductor except for 2.5 sq. mm size which shall be copper conductor.

42.02.00 **Motor Module Selection table**

Sl. No.	Motor rating kW	Max. Motor Amp.	Switch rating Amp.	Fuse rating Amp.	Contactor rating Amp.	Cable size Sq. mm
1.	1.1-1.5	3.5	16	6/16	16	3CX2.5
2.	1.6.3.0	7	32	20	16	3CX2.5
3.	3.1-5.5	11	32	32	16	3CX6
4.	5.6-7.0	14.4	63	50	32	3CX6
5.	7.1-13.0	27.3	63	63	32	3CX16
6.	13.1-24.0	45	125	80/100	63	3CX35
7.	24.1-37.0	70	125	125	70 (upto 30kW) 100 (above 30kW)	3CX70
8.	37.1-55.0	100	250	160	100(upto 40kW) 160 (upto 55kW)	3CX120
9.	55.1-80.0	150	250	200	200	3CX150
10.	80.1-100	180	As per selected fuse	Suitable for type-II	225	3CX150 (upto 90kW) 3CX240 (above 90kW)
12.	110.0-200.0	CIRCUIT BREAKER				3-1CX300

Note i) The cables of size below 120 sq. mm shall be PVC insulated and those of size above 120 sq. mm shall be XLPE insulated.

ii) All cables shall be of aluminum conductor except for 2.5 sq. mm size which shall be copper conductor.

Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y																
Complete Motor	Y	Y	Y												Y	Y	Y	Y1	Y

Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant
supporting documents during QP finalization. However, No QP for LT motor upto 50KW.
2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard
3. Makes of major bought out items for HT motors will be subject to NTPC approval.
4. Y1 = for HT Motor / Machines only.

MOTOR

TESTS/CHECKS / TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating /General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034\IEC 60079-I/ IS-12615	vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y										
Shaft	Y	Y	Y	Y	Y	Y			Y										
Magnetic Material	Y	Y	Y	Y			Y			Y		Y							
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y										
Stator copper	Y	Y	Y	Y			Y		Y			Y							
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y										
Insulating Material	Y		Y	Y			Y					Y							
Tubes, for Cooler	Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y											
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y											
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y										
Wound stator	Y	Y					Y	Y											
Wound Exciter	Y	Y					Y	Y											
Rotor complete	Y	Y					Y						Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y												

NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	**STANDARD QUALITY PLAN** (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 REV-01 DATE : 29/11/2018 Page 1 of 8	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		10			11
Instructions: 1) Cable manufacturer to maintain records to show co- relation of raw materials to finished cables i,e raw material batch/ lot no. should be traceable to the cable drum. 2) Cable manufacturer to maintain all quality control records identified as per all QP stages enumerated below whether it is identified for NTPC verification or witness or not.														
A	**Raw material/ Bought out Items**													
1.01	Copper	1.Make	MA	Verify	100%	--	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	QCR		V	--	--	
		2. Resistivity	MA	Elect	As per cable mnfr std.	--	IS 613	IS 613	-do--		P	--	--	
1.02	PVC compound for insulation	1. Make	MA	Verify	--do--	100%	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	--do--		V	V	--	
		2. Type/ Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	-do--		V	V	V	
		3. All acceptance test as per manufacturer norms	MA	Verify	As per manufacturer norms	As per manufacturer norms	--do--	--do--	--do--		V	V	V	Refer note 1
1.03	PVC Compound for Inner sheath	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V	
		2. Type/ Grade	MA	Verify	--do--	--do--	NTPC ADS	NTPC ADS	--do--		V	V	V	
1.04	Steel wire / Formed Wire (As applicable)	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V	
		2. Dimension	MA	Meas	1 sample from each size / lot	--	NTPC APPROVED DATA SHEET & IS 3975	NTPC APPROVED DATA SHEET & IS 3975	--do--		P	--	--	
		3. All acceptance tests as per IS 3975	MA	Verify	As per IS 3975	--	IS 3975	IS 3975	Supplier TC		V	V	--	
1.05	PVC compound for Sheath	1. Make	MA	Verfy	As per manufacturer norms	100%	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	QCR		V	V	--	
		2. Type / Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	--do--		V	V	V	
		3. All acceptance test as per manufacturer norms	MA	Verify	As per manufacturer norms	As per manufacturer norms	--do--	--do--	--do--		V	V	V	Refer note 1
		4. Thermal Stability	MA	Chem	One sample / Batch	--	NTPC ADS	NTPC ADS	QCR		P	--	--	
		5. Oxygen Index	MA	Chem	--do--	--	NTPC ADS/ IS 10810 Part 58	NTPC ADS/ IS 10810 Part 58	--do--		P	---	--	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

FORMAT NO:QS-01-QA1-P-10/F3-R1

NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	**STANDARD QUALITY PLAN** (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 REV-01 DATE : Page 2 of 8	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		10			11
		6. Acid Gas Emission	MA	Chem	--do--	--	NTPC ADS / IEC60754	NTPC ADS / IEC60754	--do--		P	--	--	
1.06	Wooden Drum	1. Dimension	MI	Meas	Manuf. Std.	--	IS 10418	IS10418	QCR		P	--	--	
		2. Anti termite treatment	MI	Chem	Cable manuf. std	--	CABLE MANUF. STD.	CABLE MANUF. STD.	COC		V	V	V	COC from drum manuf.
1.07	Steel Drum	1. Dimension	MI	Meas	--do--	--	--do--	--do--	QCR		P	--	--	
		2. Surface finish	MI	Meas	--do--	--	--do--	--do--	--do-		P	--	--	
B	**Process & Stage Inspection**													
2.01	Wire Drawing	1.Surface finish	MA	Visual	One sample/Setting of each size	--	SHOULD BE SMOOTH & FREE FROM SCRATCHES	SHOULD BE SMOOTH & FREE FROM SCRATCHES	QCR		P	--	--	
		2. Wire Diameter	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	–	
		3. Annealing Test	CR	Mech	--do--	Same as 6M	IS8130/NTPC ADS	IS8130/NTPC ADS	---do--		P	V	V	Refer Sl. No. 3.03(iii).
2.02	Bunching / stranding	1. No. of wires	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		2.Dia of wire	MA	Meas	-do--	--	--do--	--do--	--do--		P	--	--	
		3. Dimension of Conductor	MA	Meas	--do--		--do--	--do--	--do--		P	--	--	
		4.Direction of lay	MA	Visual	--do--	---	--do-	--do--	--do--		P	--	--	
		5.Records of strand breakage / welding during conductor stranding	MA	Verify	--do--	--	IS 8130	IS8130	--do--		P	--	--	
		6.Surface finish	MA	Visual	--do--	-	--do--	--do--	--do--		P	--	--	
		7. DC Resistance	CR	Meas	--do--	-	IS8130/NTPC ADS	IS8130/ NTPC ADS	--do---		P	--	--	
2.03	Insulation extrusion	1. Surface finish	MA	Visual	--do--	-	NTPC spec	SHOULD BE SMOOTH. NO POROSITY IS PERMITTED.	--do--		P	--	--	PVC compound shall be preferably loaded in to extruder by suction method.
		2.Colour of cores	MA	Visual	--do--	-	NTPC ADS	NTPC ADS	--do--		P	--	--	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

एनटीपीसी NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	**STANDARD QUALITY PLAN** (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 REV-01 DATE : Page 3 of 8	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		10			11
		3.Core identification	MA	Visual	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	QCR		P	--	---	Core printing shall be legible & indelible
		4.Thickness	CR	Meas	--do--	--	--do-	-do-	--do--		P	--	--	
		5.Spark Test	CR	Elect	100%	100%	CABLE MANUF. STD.	No FAILURE	QCR		P	V	V	1.Spark test failure record is to be verified. 2.Core repairing not permitted
2.04	Laying up	1. Core sequence	MA	Visual	One sample/Setting of each size	--	IS 1554 (Part I)	IS 1554 (Part I)	--do--		P	--	--	
		2. Direction of lay	MA	Visual	--do--	--	-do-	--do--	--do--		P	--	--	
		3. Dia over laid up core	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.05	Inner Sheath	1.Colour	MA	Visual	-do--	-	--do--	--do--	--do--		P	--	---	
		2. Surface Finish	MA	Visual	100%	-	NTPC SPECIFICATION	FISH EYE, BLOW HOLE NOT PERMITTED	--do--		P	--	-	
		3.Thickness	MA	Meas	One sample/Setting of each size	-	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Dia over inner sheath	MI	Meas	--do--.	-	--do--	---do--	--do--		P	--	--	
2.06	Armouring (As Applicable)	1.Dimension	MA	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		2.No. of wires / strip	MA	Meas.	--do--	-	--do--	--do--	--do--		P	--	--	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

FORMAT NO:QS-01-QA1-P-10/F3-R1

एनटीपीसी NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	**STANDARD QUALITY PLAN** (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 REV-01 DATE : Page 4 of 8	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		10			11
		3. Direction of lay	MA	Visual	One sample/Setting of each size	--	IS 1554 (Part 1)	IS 1554 (Part 1)	QCR		P	--	--	
		4.Coverage & Quality of armouring	MA	Meas.	100%	--	Min. area of coverage of armouring shall be 90%. The gap between amour wires / formed wires shall not exceed one amour wire/ formed wire space & there shall be no cross over/ over riding of amour wire / formed wire. Zn rich paint shall be applied on amour joint surface of G.S. Wire /formed wire. The breaking load of amour wire joint shall not be less than 95% of that amour wire / formed wire. (As per NTPC specification)		--do--		P	--	--	
		5 Dia over armouring	MA	Meas.	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.07	Outer Sheath	1. Surface finish	MA	Visual	100%	--	Pimple, Fish Eye, Burnt particles, Blow Hole not permitted. Repairing on outer sheath not permitted. (As per NTPC specification)		QCR		P	--	--	PVC FRLS compound shall be preferably loaded in to extruder by suction method.
		2.Colour of sheath	MA	Visual	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	QCR		P	--	--	
		3. Dia over outer sheath	MA	Meas	--do--	--	--do-	--do--	--do--		P	--	--	
		4.Thickness of outer sheath	CR	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		5. Embossing quality	MA	Visual	100%	-	Drum No.,IS 1554(Part 1) Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (As per NTPC specification)		--do--		P	--	--	Drum No. on Cable may be embossed/ printed

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
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एनटीपीसी NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	**STANDARD QUALITY PLAN** (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 REV-01 DATE : Page 5 of 8	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/N				D*	M	C	N	
1	2	3	4	5	6		7	8	9			10		11
		6. Sequencial marking	MA	Visual	Full length	--	Sequencial marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic in line & marking shall be legible & indelible. (A s per NTPC specification) In addition, Drum No. is also to be embossed/printed on full cable length	--do--	--do--		P	--	--	
C	**Finished Cables**													
3.01	Type test reports clearance from NTPC Engineering	All type tests as per NTPC specification	CR	Doc.	100%	100%	NTPC SPECIFICATION / NTPC ADS / IS 1554 (PartI)	NTPC SPECIFICATION / NTPC ADS / IS 1554 (PartI)	QCR	✓	P	V	V	
3.02	Routine Tests	1.High Voltage test at room temperature	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I)	NTPC ADS / IS 1554 (Part I)	Test certific ate	✓	P	W	V	Refer note 2
		2.Conductor Resistance	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I)	NTPC ADS / IS 1554 (Part I)	--do--	✓	P	W	V	
3.03	**Acceptance Tests**													
3.03(i)	Construction of finished Cable	1. OD of Cable	MA	Meas.	Each type & size of cables as per sampling plan of IS 1554 (Part 1)		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		2. Laying of core	CR	Visual	--do--		NTPC ADS / IS 1554 (Part I)	NTPC ADS / IS 1554 (Part I)	Test certific ate	✓	P	W	W	
		3. Core Identification	CR	Visual	--do--		--do--	--do--	--do--	✓	P	W	W	Core printing shall be legible & indelible
		4. Colour of outer sheath	MA	Visual	--do--		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		5. Inner sheath thickness	CR	Meas	- do -		--do--	--do--	--do--	✓	P	W	W	
		6. Inner sheath colour	MA	Visual	- do -		- do -	- do -	--do--	✓	P	W	W	
3.03 (ii)	Armour wires/ Formed wires (if applicable)	1.Dimensions	CR	Meas	Each type & size of cables as per sampling plan of IS 1554 (Part 1)		NTPC ADS /IS1554(PartI)/IS3975	NTPC ADS /IS1554(PartI)/IS3975	--do--	✓	P	V	V	
		2. No. of wires/ formed wire	CR	Mech	-- do --		--do--	--do--	--do--	✓	P	V	V	
		3. Tensile test	CR	Mech	--do--		--do-	--do--	--do--	✓	P	V	V	

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-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	**STANDARD QUALITY PLAN** (CONFORMING TO CODE: IS 1554 PART I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 REV-01 DATE : Page 6 of 8	REVIEWED BY AMAN PANDEY, RAJESH SHARMA, S K LAL, DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check M	Quantum of check C/ N	Reference Document	Acceptance Norms	Record Format	Agency D*	Agency M	Agency C	Agency N	Remarks
1	2	3	4	5	6		7	8	9		10			11
		4. Elongation test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	V	V	
		5.Torsion test (for round wires only)	CR	Mech	--do--		--do--	--do--	--do--	✓	P	V	V	
		6. Wrapping test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	V	V	
		7. Resistance test	CR	Mech	--do--		--do--	--do-	--do-	✓	P	V	V	
		8.Mass of Zinc coating	CR	Meas	--do--		--do--	--do--	--do--	✓	P	V	V	
		9. Uniformity of Zinc Coating	CR	Chem.	--do--		--do--	--do--	--do--	✓	P	V	V	
		10.Adhesion test	CR	Mech	--do--		--do--	--do-	--do--	✓	P	V	V	
		11.Freedom from defects	CR	Visual	--do--		--do--	--do--	--do--	✓	P	V	V	
3.03 (iii)	Conductor	1. Annealing Test	CR	Mech	-do--		NTPC ADS/ IS 8130	NTPC ADS/ IS 8130	--do--	✓	P	V	V	Refer Sl. No. 2.01
		2.Resistance Test	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W	
3.03 (iv)	PVC Insulation & PVC Sheath	1.Thickness of insulation & sheath	CR	Meas.	--do-		NTPC ADS/ IS 1554(PartI)	NTPC ADS/ IS 1554(PartI)	--do--	✓	P	W	W	
		2.Tensile strength & elongation at break of insulation & outer sheath	CR	Mech	--do-		--do--	NTPC ADS/ IS 1554(PartI)	--do--	✓	P	W	W	
		3.Tensile strength & elongation of PVC at break of insulation & outer sheath (Ageing Test)	CR	Mech	One sample per batch of offered lot irrespective of sizes		NTPC ADS/ IS 1554(PartI)	NTPC ADS/ IS 1554(PartI)	Test certificate	✓	P	V	V	MTR of the offered lot shall be verified
		4. Insulation resistance (Volume resistivity method)	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1)		--do--	NTPC ADS/ IS 1554(PartI)	--do--	✓	P	W	W	
		5.High voltage test at room temperature	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W	
		6.Thermal stability on PVC Insulation and outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		-do--	--do--	--do--	✓	P	W	W	
		7.Oxygen index Test on outer sheath	CR	Chem	--do--		NTPC ADS / IS10810 Part 58	NTPC A.D.S	Test certificate	✓	P	W	W	Refer Note 3
		8.Smoke density rating test on outer sheath	CR	Chem	--do--		NTPC ADS & ASTMD2843	NTPC ADS	-do--	✓	P	W	W	Refer Note 3

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एनटीपीसी NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	**STANDARD QUALITY PLAN** (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 REV-01 DATE : Page 7 of 8	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9			10		11
		9.Acid gas generation test on outer sheath	CR	Chem	--do--		NTPC ADS & IEC 60754-1	'NTPC ADS	--do--	✓	P	W	W	Refer Note 3
		10.Flammability test on completed cable	CR	Chem	Refer Note 4	Refer Note 4	NTPC ADS & IEC 60332 Part-3 (Category-B)	NTPC ADS	--do--	✓	P	W	W	
		11.Surface finish & length measurement.	CR	Visual & Meas	100% (COC from Manufacturer to be submitted for surface finish as per specification's requirement)	one length of each offered lot of 50 drums of all sizes	(1)IS1554Part-I (2)Cable size, Voltage grade & Words " FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (3) Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible (4) drum / Batch number marking on outer sheath		--do--	✓	P	W	W	Pimple, Fish Eye, Burnt particles, Blow Hole etc. not permitted. Repairing on outer sheath not permitted.
		12. Sequence of cores armour coverage, gap between two consecutive armour/ formed wire	CR	Visual & Meas	One length of each size	One length of each size	Min. area of coverage of armouring shall be 90%. The gap between armour wires / formed wires shall not exceed one armour wire/ formed wire space & there shall be no cross over/ over riding of armour wire / formed wire. Zn rich paint shall be applied on armour joint surface of G.S. Wire /formed wire		--do--	√	P	W	W	
4	Packing	1. Sealing	MA	Visual	100%	100%	(1)IS 1554(Part-I) (2) The surface of the drum and the outer most cable layer shall be covered with water proof cover. (3) Both the ends of cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by "U" nails.		QCR	✓	P	--	--	
4.01	Identification	NTPC Sealing	MA	Visual	100%	100%	Sealing shall be visible	Sealing shall be visible	--do--	✓	P	V	V	

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FORMAT NO:QS-01-QA1-P-10/F3-R1

एनटीपीसी NTPC	Item: 1.1 KV PVC Insulated FRLS Control cables	**STANDARD QUALITY PLAN** (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 REV-01 DATE : Page 8 of 8	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA Approved

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Record Format	Agency	Remarks

Notes:

1)	If the compound manufacturer is carrying out Ageing test, test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer is to carry out ageing test & test report is to be reviewed (quantum of ageing test sample shall be one sample /batch)
2)	2(a) **In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre**:- Routine Test of manufacturer internal test report are to be verified by NTPC at the time of final inspection. 2(b) **In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre**:- Routine Test are to be witnessed by Main Contractor on 100% basis. This is in addition to manufacturer internal test report to be verified by NTPC at the time of final inspection. Same is to be verified by NTPC
3)	1. **For Smoke Density rating test**: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection. 2. **For Acid Gas Generation test**: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection. 3. **For Oxygen Index test**: if the test result without conditioning is within (+)7% of the minimum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection. 4. In case the test results without conditioning do not meet the maximum/minimum specified value, the manufacturer may exercise the option of retesting the samples after conditioning as per standard.
4)	This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured, unarmoured) will be bunched together, as per calculations in line with the IEC. All sizes of armoured & unarmoured cables shall be covered.
LEGEND:	**NTPC ADS: NTPC approved data sheet, QCR: quality control records of cable manufacturer, CABLE MANUF STD- cable manufacturer's internal plant standard, MI: minor, MA: major, CR: critical, COC- certificate of conformance**

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN .		SPEC. NO :	DATE:27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-006, REV-02	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 2

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	-DO-		P	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	-DO-		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	SAME AS COL.7	LOG BOOK		P	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	-DO-	100%	100%	IS-325 / IS-12615/ APPROVED DATA SHEET	SAME AS COL.7	TEST/ INSPN. REPORT		P	W	W	NOTE -1 & NOTE-2
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET	TEST/ INSPN. REPORT		P	W	W	NOTE -1 & NOTE-2

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	27/2/2020	Hema K.	Checked by:	27/2/20	KUNAL GANDHI		
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:				

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:27.02.2020
		CUSTOMER :		QP NO.: PED-606-00-Q-006, REV-02	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 2

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	100%	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL.7	TEST/ INSPN. REPORT		P	W	W	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / APPROVED PACKING DRAWING.(#)	AS PER MFG. STANDARD / APPROVED PACKING DRAWING.(#).	INSPC. REPORT		P	W	-	(#) APPLICABLE FOR EXPORT JOBS

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

LEGENDS:

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

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Hema K.	Checked by:	27/2/20	KUNAL GANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

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 :	
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04	DATE:27.02.2020
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	-DO-		P	-	-	
		3 PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-	-DO-	-DO-	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	SUPPLIERS TC & LOG		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	SUPPLIER'S TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	2/3/2020	Hema K.	Checked by:	2/3/20	MUNAF GANDHI
Reviewed by:	2/3/2020	P.Dutta	Reviewed by:		

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:27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	CN				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	-DO-		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG / STD.	SUPPLIER'S TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	-DO-	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	100%	ASTM-A388	MANUFACTURER'S STD.	-DO-	✓	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	-DO-		P/V	-	-	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	-DO-		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	-DO-	-DO-	TEST REPORT		P/V	-	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	27/2/2020	Hema K.	Checked by:	27/2/20	KUNAL GANDHI		
Reviewed by:	27/2/2020	P. Dutta	Reviewed by:				

FOR CUSTOMER REVIEW & APPROVAL			
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Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04	DATE:27.02.2020
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	-DO-		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG / STD.	SUPPLIER'S TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2.ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	SUPPLIERS TC & VENDOR'S TEST REPORTS		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Henry K.	Checked by:	27/2/20	KUNAL GANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

बीएचईएल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO :	DATE:27.02.2020
		CUSTOMER :	QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM:	SECTION: II	SHEET 4 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-	-DO-	-DO-	Log Book -DO-		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET			P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	-DO-		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	-DO-		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	-DO-	-DO-		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S ORG	MANUFACTURER'S DRG	-DO-		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	-DO-		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	-DO-	-DO-	-DO-		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	-DO-		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	-DO-		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S ORG	-DO-		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Hema K.	Checked by:	27/2/20	KUNAL CHAKRABORTY
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
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Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:27.02.2020
	CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 5 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	100%	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	-DO-	✓	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	SAME AS COL.7	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	-DO-	-DO-	-DO-		P	-	-	
		3 SHADE	MA	VISUAL	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Hema R.	Checked by:	28/2/20	KUNAL GANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:27.02.2020
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		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 6 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	-DO-	-DO-	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	100%	100%	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	LOG BOOK	✓	P	V	-	
		4.RESISTANCE	CR	-DO-	100%	100%	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	LOG BOOK	✓	P	V	-	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFR'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	-DO-	CONTINUOUS	CONTINUOUS	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✓	P	V	-	THREE DIPS TO BE GIVEN

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	2/3/2020	Hema K.	Checked by:	2/3/20	KUNAL GANDHI		
Reviewed by:	02/3/2020	P.Dutta	Reviewed by:				

FOR CUSTOMER REVIEW & APPROVAL			
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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 7 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	-	**			
					M	C/N				D	M	C	N	
		4.DURATION	MA	-DO-	CONTINUOUS	CONTINUOUS	-DO-	-DO-	LOG BOOK	✓	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	-DO-	-DO-	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
		3.HV	MA	ELECT. TEST	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	100%	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✓	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
		4.DIMENSIONS	MA	-DO-	-DO-	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG/ RELEVANT IS	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	100%	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✓	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Hema K.	Checked by:		RUNAL GANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
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Approved by:			

BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO :	DATE:27.02.2020
		CUSTOMER :	QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM:	SECTION: II	SHEET 5 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT		P	W"	W"	" NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	-DO-	100%	100%	-DO-	-DO-	-DO-		P	V /W$	V /W$	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	100%	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	-DO-		P	V /W$	V /W$	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT		P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	1/TYPE/ SIZE	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✓	P	V	V	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	100%	IS-325//IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	-DO-		P	V /W$	V /W$	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	100%	IS-325//IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	-DO-		P	V /W$	V /W$	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	100%	IS-325//IS-12615& DATA SHEET	IS-325/IS-12615 & DATA SHEET	TEST/INSPC. REPORT		P	V /W$	V /W$	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	1/TYPE	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✓	P	V	V	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC		P	W$	W$	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	3/2/2020	Heena K.	Checked by:	3/2/20	KUNAL GANDHI
Reviewed by:	03/2/2020	P. Dutt	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO.	DATE:27.02.2020
		CUSTOMER:		QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 9 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING.	AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING.	INSPC. REPORT		P	W	-	IF APPLICABLE, REFER SEAWORTHY PACKING ALSO.

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, C: CUSTOMER,

P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE

MA: MAJOR, MI: MINOR, CR: CRITICAL

D: DOCUMENT

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	2/3/2020	Hemma K.	Checked by:	2/3/20	KUNAL GANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE-S-041 REV-01 DATE : 29/11/2018 Page 1 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA 25.11.18 S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/N				D *	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
Instructions: 1) Cable manufacturer to maintain records to show co- relation of raw materials to finished cables i,e raw material batch/ lot no. should be traceable to the cable drum. 2) Cable manufacturer to maintain all quality control records identified as per all QP stages enumerated below whether it is identified for NTPC verification or witness or not.														
A	**Raw material/ Brought out Items**													
1.01	Aluminum	1.Make	MA	Verify	100%	--	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	QCR		V	--	--	
		2. Resistivity	MA	Elect	As per Cable Mnfr Std.	--	IS5082	IS5082	-do--		P	--	--	
1.02	PVC / XLPE/compound for insulation	1. Make	MA	Verify	--do--	100%	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	--do--		V	V	--	
		2. Type/ Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	--do--		V	V	V	
		3. All acceptance test as per manufacturer norms including thermal stability test for PVC insulation	MA	Verify	As per manufacturer norms	As per manufacturer norms	NTPC ADS	NTPC ADS	--do--		V	V	V	Refer note 1
1.03	PVC Compound for Inner sheath	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V	
		2. Type/ Grade	MA	Verify	--do--	--do--	NTPC ADS	NTPC ADS	--do--		V	V	V	
1.04	Steel wire / Formed Wire (As applicable)	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V	
		2. Dimension	MA	Meas	1 sample from each size / lot	--	NTPC APPROVED DATA SHEET & IS 3975	NTPC APPROVED DATA SHEET & IS 3975	--do--		P	--	--	
		3. All acceptance tests as per IS 3975	MA	Verify	As per IS 3975	--	IS 3975	IS 3975	Supplier TC		V	V	--	
1.05	PVC compound for Sheath	1. Make	MA	Verfy	As per manufacturer norms	100%	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	QCR		V	V	--	
		2. Type / Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	QCR		V	V	V	

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एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 2 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		3. All acceptance test as per manufacturer norms	MA	Verify	As per manufacturer norms	As per manufacturer norms	NTPC ADS	NTPC ADS	QCR		V	V	V	Refer note 1
		4. Thermal Stability	MA	Chem	One sample / Batch	--	NTPC ADS	NTPC ADS	QCR		P	--	--	
		5. Oxygen Index	MA	Chem	--do--	--	NTPC ADS/ IS 10810 Part 58	NTPC ADS/ IS 10810 Part 58	--do--		P	---	--	
		6. Acid Gas Emission	MA	Chem	One sample / Batch	--	NTPC ADS / IEC60754	NTPC ADS / IEC60754	QCR		P	--	--	
1.06	Wooden Drum	1. Dimension	MI	Meas	Manuf. Std.	--	IS 10418	IS10418	--do--		P	--	--	
		2. Anti termite treatment	MI	Chem	Cable manuf. std	--	CABLE MANUF. STD.	CABLE MANUF. STD.	COC		V	V	V	COC from drum manuf.
1.07	Steel Drum	1. Dimension	MI	Meas	--do--	--	--do--	--do--	QCR		P	--	--	
		2. Surface finish	MI	Meas	--do--	--	--do--	--do--	--do-		P	--	--	
B	Process & Stage Inspection													
2.01	Wire Drawing	1.Surface finish	MA	Visual	One sample/Setting of each size	--	SHOULD BE SMOOTH & FREE FROM SCRATCHES	SHOULD BE SMOOTH & FREE FROM SCRATCHES	QCR		P	--	--	
		2. Wire Diameter	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		3. Tensile test	CR	Mech	--do--	--do--	--do--	--do--	--do--		P	V	V	Refer Sl. No.3.03(iii)
		4. Wrapping test	CR	Mech	--do--	--do--	--do--	--do--	--do--		P	V	V	--do--
2.02	Bunching / stranding	1. No. of wires	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		2.Dia of wire	MA	Meas	-do--	--	--do--	--do--	--do--		P	--	--	
		3. Dimension of Conductor	MA	Meas	--do--		--do--	--do--	--do--		P	--	--	
		4.Direction of lay	MA	Visual	--do--	---	--do-	--do--	--do--		P	--	--	
		5.Records of strand breakage / welding during conductor stranding	MA	Verify	--do--	--	IS 8130	IS8130	--do--		P	--	--	
		6.Surface finish	MA	Visual	--do--	-	--do--	--do--	--do--		P	--	--	
		7. DC Resistance	CR	Meas	--do--	-	IS8130/NTPC ADS	IS8130/ NTPC ADS	--do--		P	--	--	
2.03	Insulation extrusion	1. Surface finish	MA	Visual	One sample/Setting of each size	-	NTPC spec	SHOULD BE SMOOTH. NO POROSITY IS PERMITTED.	QCR		P	--	--	XLPE/ PVC compound shall be preferably loaded in to extruder by suction method.

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एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 3 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
1		2.Colour of cores	MA	Visual	One sample/Setting of each size	-	NTPC ADS	NTPC ADS	QCR		P	--	--	
		3.Thickness	CR	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Spark Test	CR	Elect	100%	100%	CABLE MANUF. STD.	No FAILURE	--do --		P	V	V	1.Spark test failure record is to be verified. 2.Core repairing not permitted
		5. Hot Set	CR	Mech	One sample/Setting of each size	--	IS 7098- Part I	IS 7098- Part I	--do--		P	--	--	Sample is to be taken from both top & bottom end
2.04	Laying up	1. Core sequence	MA	Visual	--do--	--	IS 1554 (Part I) & IS 7098- Part I	IS 1554 (Part I) & IS 7098- Part I	--do--		P	--	--	
		2. Direction of lay	MA	Visual	--do--	--	-do-	--do--	--do--		P	--	--	
		3. Dia over laid up core	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.05	Inner Sheath	1.Colour	MA	Visual	-do--	-	--do--	--do--	--do--		P	--	--	
		2. Surface Finish	MA	Visual	100%	-	NTPC SPECIFICATION	FISH EYE, BLOW HOLE NOT PERMITTED	--do--		P	--	-	
		3.Thickness	MA	Meas	One sample/Setting of each size	-	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Dia over inner sheath	MI	Meas	--do--.	-	--do--	--do--	--do--		P	--	--	
2.06	Armouring (As Applicable)	1.Dimension	MA	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		2.No. of wires / strip	MA	Meas.	--do--	-	--do--	--do--	--do--		P	--	--	
		3. Direction of lay	MA	Visual	--do--	--	IS 1554 (Part I) & IS 7098- Part I	IS 1554 (Part I) & IS 7098- Part I	QCR		P	--	--	

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एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 4 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		10			11
		4.Coverage & Quality of armouring	MA	Meas.	100%	--	Min. area of coverage of armouring shall be 90%. The gap between amour wires / formed wires shall not exceed one amour wire/ formed wire space & there shall be no cross over/ over riding of amour wire / formed wire. Zn rich paint shall be applied on amour joint surface of G.S. Wire /formed wire. The breaking load of amour wire joint shall not be less than 95% of that amour wire / formed wire. (As per NTPC specification)		QCR		P	--	--	
		5 Dia over armouring	MA	Meas.	One sample/Setting of each size	--	NTPC ADS		--do--		P	--	--	--
2.07	Outer Sheath	1. Surface finish	MA	Visual	100%	--	Pimple, Fish Eye, Burnt particles, Blow Hole not permitted. Repairing on outer sheath not permitted. (As per NTPC specification)		--do--		P	--	--	PVC FRLS compound shall be preferably loaded in to extruder by suction method.
		2.Colour of sheath	MA	Visual	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		3. Dia over outer sheath	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Thickness of outer sheath	CR	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		5. Embossing quality	MA	Visual	100%	-	Drum No.,IS1554-I & IS7098-1,Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (As per NTPC specification)		--do--		P	--	--	Drum No. on Cable may be embossed/printed
		6. Sequencial marking	MA	Visual	Full length	--	Sequencial marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible. (A s per NTPC specification) In addition, Drum No. is also to be embossed/printed on full cable length		--do--		P	--	--	
C	Finished Cables													
3.01	Type test reports clearance from NTPC	All type tests as per NTPC specification	CR	Doc.	100%	100%	NTPC SPECIFICATION / NTPC ADS / IS 1554 (Partl) & IS 7098-Part I	NTPC SPECIFICATION / NTPC ADS / IS 1554 (Partl) & IS	--do--	✓	P	V	V	

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					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
3.02	Routine Tests	1.High Voltage test at room temperature	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	Test certific ate	✓	P	W	V	Refer note 2
		2.Conductor Resistance	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	Test certific ate	✓	P	W	V	Refer note 2
3.03	Acceptance Tests													
3.03 (i)	Construction of finished Cable	1. OD of Cable	MA	Meas.	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		2. Laying of core	CR	Visual	--do--		NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	--do--	✓	P	W	W	
		3. Core Identification	CR	Visual	--do--		--do--	--do--	--do--	✓	P	W	W	
		4. Colour of outer sheath	MA	Visual	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		5. Inner sheath thickness	CR	Meas	- do -		--do--	--do--	--do--	✓	P	W	W	
		6. Inner sheath colour	MA	Visual	- do -		- do -	- do -	--do--	✓	P	W	W	
3.03 (ii)	Armour wires/ Formed wires (if applicable)	1.Dimensions	CR	Meas	--do--		NTPC ADS /IS1554(PartI)/IS3975	NTPC ADS /IS1554(PartI) /IS3975	--do--	✓	P	W	W	
		2. No. of wires/ formed wire	CR	Mech	-- do --		--do--	--do--	--do--	✓	P	W	W	
		3. Tensile test	CR	Mech	--do--		--do-	--do--	--do--	✓	P	V	V	
		4. Elongation test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	V	V	
		5.Torsion test (for round wires only)	CR	Mech	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		--do--	--do--	--do--	✓	P	V	V	
		6. Wrapping test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	V	V	
		7. Resistance test	CR	Mech	--do--		--do--	--do-	--do-	✓	P	V	V	

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					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		8.Mass of Zinc coating	CR	Meas	--do--		--do--	--do--	--do--	✓	P	V	V	
		9. Uniformity of Zinc Coating	CR	Chem.	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098-Part I		NTPC ADS /IS1554(PartI)/IS3975	NTPC ADS /IS1554(PartI) /IS3975	Test certific ate	✓	P	V	V	
		10.Adhesion test	CR	Mech	--do--		--do--	--do-	--do--	✓	P	V	V	
		11.Freedom from defects	CR	Visual	--do--		--do--	--do--	--do--	✓	P	V	V	
3.03 (iii)	Conductor													
		1.Resistance Test	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W	
		2.Tensile test (For aluminum conductor only)	CR	Mech	Each type & size of cables as per sampling plan of IS IS 1554 (Part I)/7098(Part-I)		NTPC ADS/ IS 8130	NTPC ADS/ IS 8130	--do--	✓	P	W	W	Test report of manufacturer to be reviewed as per Sl. No. 2.01 for Tensile test & wrapping test (for Aluminum) in case this test is not applicable for cable under inspection as per IS 8130 cl. 6.2
		3.Wrapping test (For aluminum conductor only)	CR	Mech	--do--		--do--	--do--	-do--	√	P	P	W	--do--
3.03 (iv)	PVC / XLPE Insulation & PVC Sheath	1.Thickness of insulation & sheath	CR	Meas.	--do-		NTPC ADS/ IS 1554(PartI) & IS 7098-Part I	NTPC ADS/ IS 1554(PartI) & IS 7098-Part I	--do--	✓	P	W	W	

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1	2	3	4	5	6		7	8	9	10				11
		2.Tensile strength & elongation at break of insulation & outer sheath	CR	Mech	Each type & size of cables as per sampling plan of IS IS 1554 (Part 1)/IS7098(Part-1)		NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	Test Certific ate	✓	P	W	W	
		3.Tensile strength & elongation of PVC at break of insulation & outer sheath (Ageing Test)	CR	Mech	One sample per batch of offered lot irrespective of sizes		--do--	--do--	--do--	✓	P	V	V	MTR for Ageing Test of the offered lot shall be verified
		3a. Tensile strength & elongation of XLPE at break of insulation (Ageing Test)	CR	Mech	--do--		NTPC ADS/ IS 7098 Part I	NTPC ADS/ IS 7098 Part I	--do--	√	P	V	V	MTR for Ageing Test of the offered lot shall be verified
		4. Insulation resistance (Volume resistivity method)	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		--do--	NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	--do--	✓	P	W	W	
		5.High voltage test at room temperature	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		--do--	--do--	--do--	✓	P	W	W	
		6.Thermal stability on PVC Insulation and outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		-do--	--do--	--do--	✓	P	W	W	
		7. Hot Set Test (for XLPE Insulation only)	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	--do--	--do--	✓	P	W	W	
		8.Oxygen index Test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		NTPC ADS / IS10810 Part 58	NTPC A.D.S / IS10810 Part 58	Test certific ate	✓	P	W	W	Refer Note 3

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1	2	3	4	5	6		7	8	9	10				11
		9.Smoke density rating test on outer sheath	CR	Chem	--do--		NTPC ADS & ASTMD2843	NTPC ADS	-do--	✓	P	W	W	Refer Note 3
		10.Acid gas generation test on outer sheath	CR	Chem	--do--		NTPC ADS & IEC 60754-1	'NTPC ADS	Test Certific ate	✓	P	W	W	Refer Note 3
		11.Flammability test on completed cable	CR	Chem	Refer Note 4	Refer Note 4	NTPC ADS & IEC 60332 Part-3 (Category-B)	NTPC ADS	--do--	✓	P	W	W	
		12.Surface finish & length measurement.	CR	Visual & Meas	100% (COC from Manufacturer to be submitted for surface finish as per specification's requirement)	one length of each offered lot of 50 drums of all sizes	(1) IS1554-I & IS7098-1, Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (2) Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible	--do--	✓	P	W	W	Pimple, Fish Eye, Burnt particles, Blow Hole etc. not permitted. Repairing on outer sheath not permitted.
		13. Sequence of cores armour coverage, gap between two consecutive armour/ formed wire	CR	Visual & Meas	One length of each size	One length of each size	Min. area of coverage of armouring shall be 90%. The gap between armour wires / formed wires shall not exceed one armour wire/ formed wire space & there shall be no cross over/ over riding of armour wire / formed wire. Zn rich paint shall be applied on armour joint surface of G.S. Wire /formed wire	--do-	√	P	W	W	
4	Packing	1. Sealing	MA	Visual	100%	100%	(1)IS1554(Part-I) & IS 7098-Part I (2) The surface of the drum and the outer most cable layer shall be covered with water proof cover. (3) Both the ends of cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by "U" nails.	QCR	✓	P	--	--	
4.01	Identification	NTPC Sealing	MA	Visual	100%	100%	Sealing shall be visible	QCR	√	P	V	V	

एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 9 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA Approved

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11

Notes:

1)	If the compound manufacturer is carrying out Ageing test, test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer is to carry out ageing test & test report is to be reviewed (quantum of ageing test sample shall be one sample /batch)
2)	2(a) **In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre**:- Routine Test of manufacturer internal test report are to be verified by NTPC at the time of final inspection. 2(b) **In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre**:- Routine Test are to be witnessed by Main Contractor on 100% basis. This is in addition to manufacturer internal test report to be verified by NTPC at the time of final inspection. Same is to be verified by NTPC
3)	1. For Smoke Density rating test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection. 2. For Acid Gas Generation test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection. 3. For Oxygen Index test: if the test result without conditioning is within (+)7% of the minimum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection. 4. In case the test results without conditioning donot meet the maximum/minimum specified value, the manufacturer may exercise the option of retesting the samples after conditioning as per standard.
4)	For PVC insulated LT power cable :- For cables with OD less than equal to 30 mm, any size of cable may be clubbed together. For cables where OD is more than 30 mm, clubbing to be done for cables having similar ODs. For XLPE insulated LT Power cable: Clubbing to be done for cables having similar ODs.
LEGEND:	**NTPC ADS: NTPC approved data sheet, QCR: quality control records of cable manufacturer, CABLE MANUF. STD- cable manufacturer's internal plant standard, MI: minor, MA: major, CR: critical, COC- certificate of conformance**

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

FORMAT NO:QS-01-QA1-P-10/F3-R1

ITEM : Instrumentation Cables.
SUB SYSTEM : Shielded Instrument/ TC extension/ Compensating PVC FRLS Cable

STANDARD QUALITY PLAN

To be filled by NTPC
QP No.: 0000-999-QOI-S-035
Revision:00
Date:05/09/2012
Page:1 OF 5
Valid up to : 04/09/2015

Reviewed By: Archana Nath, Rajeev Garg, S.samanta
Approved By: A.K.GARG

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1	2	3	4	5	6		7	8	9		10			11
I.	**RAW MATERIAL**													
A	**CONDUCTOR**													
A1	COPPER ROD For Conductor/ Drain wire	a) Dimension	Maj.	Measu.	1 sample/lot	_	IS:613/IS:12444	IS:613/IS:12444	IMR/ TC		V	-	-	Make - As per Annexure enclosed
		b) Conductivity/ Resistivity	Cri.	Elec.	1 sample/lot	1 sample/lot	IS:613/IS:12444	IS:613/IS:12444	IMR/ TC		V	V	-	
A2	Conductor for compensating cable	a) Size	Min	Dimen	1 Sample / lot	_	APPROVED DATASHEET	APPROVED DATA SHEET	IMR/ TC		P	-	-	Make - As per Annexure enclosed
		b) Resistance check	Maj	Elec	1 Sample / lot	_	APPROVED DATASHEET	APPROVED DATA SHEET	IMR/ TC		P	-	-	
		c) Thermo emf	Cri	Elec	1 Sample / lot	_	ANSI MC 96.1	ANSI MC 96.1	IMR/ TC		P	-	-	
		d) Specific resistance, Temp. cofficient	Maj	Elec/Mech	1 Sample / lot	1 Sample / lot	Mfr. catalog	Mfr. catalog	IMR/ TC		V	V	V	
		e) Chemical composition.	Maj	Chem.	1 Sample / lot	1 Sample / lot	Mfr. catalog	Mfr. catalog	IMR/ TC		V	V	V	
B	**PVC COMPOUND**													
B1	PVC Compound (Insulation & Sheath) Type of compound as per NTPC Spec.	a) Thermal stability (for Insulation)	Maj.	Therm.	1 sample/lot	1 sample/lot	VDE 207 Part -4/5	VDE 207 Part -4/5	IMR/ TC		P	V	-	
		b) TS & % Elongation Before and After aging and variation.	Maj.	Mech.	1 sample/lot	1 sample/lot	VDE 207 Part -4/5	VDE 207 Part -4/5	IMR/ TC		P	V	-	
		c) Loss of Mass (Sheath)	Maj.	Therm.	1 sample/lot	1 sample/lot	VDE 207 Part -4/5	VDE 207 Part -4/5	IMR/ TC		P	V	-	
B2	FR Properties for Filler Compound	a) Oxygen index	Cri.	Chem	1 sample/lot	1 sample/lot	29 %(min)ASTMD2863	29%(min)ASTMD2863	IMR/ TC		P	V	-	
		b) Temperature index deg. C	Cri.	Chem	1 sample/lot	1 sample/lot	250 deg. C(min) ASTMD2863	250 deg. C(min) ASTMD2863	IMR/ TC		P	V	-	
B3	FRLS Properties for Sheath	a) Oxygen index	Cri.	Chem	1 sample/lot	1 sample/lot	ASTMD2863/ APPROVED DATASHEET	ASTMD2863/ APPROVED DATASHEET	IMR/ TC		P	V	-	
		b) Temperature index	Cri.	Chem	1 sample/lot	1 sample/lot	ASTMD2863/ APPROVED DATASHEET	ASTMD2863/ APPROVED DATASHEET	IMR/ TC		P	V	-	
		c) Smoke density rating	Cri.	Chem	1 sample/lot	1 sample/lot	ASTMD2843/ APPROVED DATASHEET	ASTMD2843/ APPROVED DATASHEET	IMR/ TC		P	V	-	
		d) HCL Emission	Cri.	Chem	1 sample/lot	1 sample/lot	IEC754-1/ APPROVED DATASHEET	IEC754-1/ APPROVED DATASHEET	IMR/ TC		P	V	-	
C	Tapes / Binders (Aluminium Mylar,Melinex & Binders)	a) Thickness	Maj.	Mesu.	1 Sample/ Lot	1 Sample/ Lot	APPROVED DATASHEET	APPROVED DATASHEET	IMR/ TC		P	V	-	
		b) Size	Maj.	Mesu.	1 Sample/ Lot	1 Sample/ Lot	APPROVED DATASHEET	APPROVED DATASHEET	IMR/ TC		P	V	-	
D	Armour (If applicable)	a) Dimension	Maj.	Mesu.	1 Sample/ Lot	1 Sample/ Lot	APPROVED DATASHEET	APPROVED DATASHEET	IMR/ TC		P	V	-	
		b) TS & %Elongation	Maj.	Mech	1 Sample/ Lot	1 Sample/ Lot	IS 3975	IS 3975	IMR/ TC		P	V	-	
		c) Zn Coating	Maj.	Chem	1 Sample/ Lot	1 Sample/ Lot	IS 3975	IS 3975	IMR/ TC		P	V	-	
		d) Resistivity	Maj.	Elect	1 Sample/ Lot	1 Sample/ Lot	IS 3975	IS 3975	IMR/ TC		P	V	-	

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Format No. :QS-01-QAI-P-09/F1-R1

APPROVED
Checked and Approved.

Date: 15-Nov-2018

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NTPC

ITEM : Instrumentation Cables.
SUB SYSTEM : Shielded Instrument/ TC extension/ Compensating PVC FRLS Cable

STANDARD QUALITY PLAN

To be filled by NTPC
QP No.: 0000-999-QOI-S-035
Revision:00
Date:05/09/2012
Page:2 OF 5
Valid up to : 04/09/2015

Reviewed By: Archana Nath, Rajeev Garg, S.samanta

Approved By A.K.GARG

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E	Wooden Drums	a) Constructional checks	Maj.	Visu.	100%	–	IS 10418	IS 10418	IMR/ TC		P	-	-	
		b) Dimensions	Maj.	Mesu.	1 Sample/ Lot	–	IS 10418	IS 10418	IMR/ TC		P	-	-	
II	INPROCESS INSPECTION													
A	Wire Drawing & Anealing	a)Size	Maj.	Dimn.	1 Sample at Start and 1 Sample at End	–	Approved Datasheet	Approved Datasheet	IMR/ TC		P	-	-	
		b) Surface finish	Maj.	Visu.	100%	–	Surface shall be smooth	Surface shall be smooth	IMR/ TC		P	-	-	
		c) % of Elongation	Maj.	Mech.	1 Sample/ Lot	–	IS:8130	IS:8130	IMR/ TC		P	-	-	
B	Tinning (Only for Drain wire)	a) Size	Maj.	Dimn.	1 Sample/ Lot	–	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
		b) Percentage of Elongation	Maj.	Mech.	1 Sample/ Lot	1 Sample/ Lot	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	V	V	
C	Bunching	a) Dimension and No. of strand.	Maj.	Measu.	1 Sample/ Lot	–	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P			
		b)Resistance	Cri	Elec.	1 Sample/ Lot	1 Sample/ Lot	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	V	V	
D	Insulation	a) Surface finish	Maj.	Visu.	100%	–	Surface shall be smooth & free from scratches	Surface shall be smooth & free from scratches	IMR/ TC		P	-	-	
		b) Core Diameter	Maj.	Measu.	1 Sample/ Lot	–	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
		c) Radial Thickness(Min & Max.)	Maj.	Measu.	1 Sample/ Lot	–	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	No Repairs are allowed on the Insulated core
		d) Spark Test	Maj.	Elec.	100%	100%	IS 10810(With 3KV ac)	No Spark failure is allowed	IMR/ TC		P	V	V	
		e) Volume Resistivity/ Insulation Resistance	Maj.	Elec.	1 Sample/ Lot	1 Sample/ Lot	VDE -0207/ Approved Datasheet	VDE -0207/ Approved Datasheet	IMR/ TC		P	V	V	
		f) Colour, Marking/ Identification	Maj.	Visual	100%	100%	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	V	-	
		g) TS & %Elongation	Maj.	Mech.	1 Sample/ Lot	–	VDE -0207/ Approved Datasheet	VDE -0207/ Approved Datasheet	IMR/ TC		P	-	-	
E	Twisting	a) Lay length and Direction	Maj.	Measu. &	1 Sample at Start and 1 Sample at End	–	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
		b) Size/ Dimension	Maj.	Measu.	1 Sample/ Lot	–	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
		c) Pair Colour	Maj.	Visual	100%	–	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	

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Format No. :QS-01-QAI-P-09/F1-R1

NTPC

ITEM : Instrumentation Cables.
SUB SYSTEM : Shielded Instrument/ TC extension/ Compensating PVC FRLS Cable

STANDARD QUALITY PLAN

To be filled by NTPC
QP No.: 0000-999-QOI-S-035
Revision:00
Date:05/09/2012
Page:3 OF 5
Valid up to : 04/09/2015

Reviewed By: Archana Nath, Rajeev Garg, S.samanta

Approved By: A.K.GARG

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1	2	3	4	5	6		7	8	9		10			11
F	Laying of Pairs/ Taping/ Shielding (Wherever Applicable)	a) Construction	Maj.	Visu.	100%	_	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
		b) Dimension	Maj.	Measu.	1 Sample/ Lot	_	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
		c) Coverage/ Overlap	Maj.	Measu.	1 Sample/ Lot	_	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
		d) Continuity	Maj.	Dimn.	1 Sample/ Lot	_	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
G	Sheathing (Inner - If applicable)	a) Surface Finish	Maj.	Visual	100%	_	Smooth, free from visual defects #	Smooth, free from visual defects#	IMR/ TC			-	-	# Porosity, Burnt particles, Pimples (Repairs are not allowed)
		b) Colour	Maj.	Visual	100%	_	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
		c) Diameter / Thickness	Maj.	Measu.	1 Sample/ Lot	_	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
H	Armouring (If applicable)	a) Surface finish	Maj.	Visual	100%	_	Smooth, free from visual defects like rusting etc.	Smooth, free from visual defects like rusting etc.	IMR/ TC		P	-	-	
		b) Direction of Lay & Coverage	Maj.	Visual	100%	_	Smooth, free from visual defects like rusting etc.	Smooth, free from visual defects like rusting etc.	IMR/ TC		P	-	-	Min coverage shall be 90 %. Gap should not be more than 1 wire/ Strip dimension.
		c) Size of Wire/ Strip	Maj.	Measu.	1 Sample/ Lot	_	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
		d) Diameter over Armouring	Maj.	Measu.	1 Sample/ Lot	_	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
I	Sheathing (Outer)	a) Surface Finish	Maj.	Visual	100%	_	Smooth, free from visual defects#	Smooth, free from visual defects#	IMR/ TC		P	-	-	# Porosity, Burnt particles, Pimples (No Repairs are allowed)
		b) Colour/ Marking/ Embossing	Maj.	Visual	100%	_	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
		c) Overall Diameter, Thickness	Maj.	Measu.	1 Sample/ Lot	_	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
		d) TS & %Elongation	Maj.	Mech.	1 Sample/ Lot	_	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	IMR/ TC		P	-	-	
III. FINAL INSPECTION														
A.	TYPE TEST	Type test as per agreement with NTPC Engg. Review of type test clearence from NTPC Engg. before final Inspection - **CHP**												
B.	ROUTINE TEST	a) Cond.resistance (Cable & Drain wire)	Cri.	Elec.	100%	100%	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	V	V	
		b) HV Test	Cri.	Elec.	100%	100%	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	V	V	

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अनुमोदित Approved

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		c) IR Test (on drum length)	Cri.	Elec.	100%	100%	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	V	V	
		d) Drain wire contunity	Cri.	Elec.	100%	100%	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	V	V	
C.	ACCEPTANCE TEST	a) Cond.resistance (Cable & Drain wire)	Cri.	Elec.	Samples as per IS 1554/8784	Samples as per IS 1554/8784	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		b) HV Test	Cri.	Elec.	Samples as per IS 1554/8784	Samples as per IS 1554/8784	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		c) IR Test	Cri.	Elec.	Samples as per IS 1554/8784	Samples as per IS 1554/8784	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		d) Constructional Details & Dimensions												
		i) Constructional Details	Maj.	Visual	Samples as per IS 1554/8784	Samples as per IS 1554/8784	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		ii) Shield Al-mylar thickness	Maj.	Measu.	Samples as per IS 1554/8784	Samples as per IS 1554/8784	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		iii) Insulation thickness	Maj.	Measu.	Samples as per IS 1554/8784	Samples as per IS 1554/8784	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		iv) Inner/ Outer sheath thickness (as applicable)	Maj.	Measu.	Samples as per IS 1554/8784	Samples as per IS 1554/8784	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	before and after ageing for insulation.
		v) Diameter over outer sheath	Maj.	Measu.	Samples as per IS 1554/8784	Samples as per IS 1554/8784	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		e) Outer sheath - Colour, Marking/ Embossing & End sealing.	Maj.	Visual	Samples as per IS 1554/8784	Samples as per IS 1554/8784	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		f) Length checking.	Maj.	Measu.	1 No. of each size & type per Lot	1 No. of each size & type per Lot	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		g) Core - Band marking/ Numbering, Colour.	Maj.	Visual	1 No. of each size & type per Lot	1 No. of each size & type per Lot	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		h) Overall Coverage/overlap of shield & Continuity of drain wire.	Maj.	Visual	1 No. of each size & type per Lot	1 No. of each size & type per Lot	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	Continuity shall be checked as per Manufacturer practice.

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Reviewed By: Archana Nath, Rajeev Garg, S.samanta

Approved By: A.K.GARG

Sl No	Component & Operations	Characteristics	Class	Type of check	Quantum of check M	Quantum of check C,N	Reference Document	Acceptance Norms	Format of record	D*	Agency M	Agency C	Agency N	Remarks
1	2	3	4	5	6		7	8	9		10			11
		i) Thermal EMF test (For compensating cable only)	Maj.	Elec.	Sample as per IS 8784	Sample as per IS 8784	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		j) Thermal Stability (Insulation & Sheath)	Maj.	Chem.	1 No. of each size & type per Lot	1 No. of each size & type per Lot	Spec./ADS/IS:5831	Spec./ADS/IS:5831	FIR	√	P	W	W	
		k) Visual & Surface Finish	Maj.	Visual	1 No. of each size & type per Lot	1 No. of each size & type per Lot	Smooth, free from visual defects #	Smooth, free from visual defects #	FIR	√	P	W	W	# Like Porosity, Burnt particles, Pimples
		l) Electrical Parameters (Mutual capacitance, Cross talk, Attenuation, Charactristic Impedence as applicable)	Maj.	Elec.	1 No. of each size & type per Lot	1 No. of each size & type per Lot	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		m) Persulphate Test (For Drain wire)	Maj.	Chem.	1 No. of each size & type per Lot	1 No. of each size & type per Lot	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		n) Swidesh chimney test (overall cable)	Maj.	Chem	1 No./ Complete lot offered $	1 No./ Complete lot offered $	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	$ Irrespective of size & type.
		o) FRLS Test for outer sheath for OI(Oxygen Index), TI(Temperature Index), SDR(Smoke Density Rating) & HCL Emission.	Maj.	Chem	1 No./ Complete lot offered $	1 No./ Complete lot offered $	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		p) TS & %Elongation test of Insualtion & Sheath (Before & After aging)	Maj.	Mech	1 No./ Complete lot offered $	1 No./ Complete lot offered $	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		q) Volume Resistivity (At room and Elevated Temperature)	Maj.	Elec.	1 No./ Complete lot offered $	1 No./ Complete lot offered $	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
		r) Armouring Dimension & Zn coating. (If applicable)	Maj.	Measu.	1 No./ Complete lot offered $	1 No./ Complete lot offered $	NTPC Tech.Specfication /Approved Datasheet	NTPC Tech.Specfication /Approved Datasheet	FIR	√	P	W	W	
D.	Packaing and Dispatch	Stencileing, completeness & Verification with packing list	Maj.	Visual.	100%	-	Mfg. Practice	Mfg. Practice			P	-	-	

NOTE 1 : Where witnessing and verification of records is done only by main contractor (Coloum "C"), NTPC inspection Engineer may do a survilience Verification/ Witnessing as per his discretion.

NOTE 2 : IMR : Inword Material Register, TC : Test Certificates, Mfg. : Manufacturer, FIR : Final Inspection Report.

NOTE 3: NTPC Inspection Enginner to check,approval date,revision no of reference documents at the time of Inspection.

LEGEND : * RECORDS, IDENTIFIED WITH " TICK" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION .M:MANUFACTURER/ SUB SUPPLIER C:MAIN SUPPLIER,N:NTPC, P:PERFORM ,'W: WITNESS and V: VERIFICATION AS APPROPRIATE, "CHP" NTPC SHALL INDICATED IN COLOUM "N" AS "W"

Format No. :QS-01-QAI-P-09/F1-R1

LT SWITCHGEAR

(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES / CHARACTERIS-TICS → / ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLIY ↓	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Sheet Steel (IS : 513)	Y	Y		Y	Y		Y							
Aluminum Bus bar Material (IS : 5082)	Y	Y	Y	Y	Y		Y							
Copper Bus bar Material (IS : 613)	Y	Y	Y	Y	Y		Y							
Support Insulator	Y	Y	Y	Y			Y							
Air Circuit Breaker (IS: 13947)	Y	Y				Y	Y			Y	Y			Y
Energy Meters (IS : 13010, 13779)	Y	Y				Y	Y			Y				Y
Power & Aux. Contactors (IS : 13947)	Y	Y				Y	Y			Y				
Protection & Aux. Relays (IS : 3231) (IEC 60255 / IEC 61850)	Y	Y				Y	Y			Y				Y
Control & Selector Switches (IS : 13947)	Y	Y				Y	Y			Y				
CT's & PT's (IS 2705 / 3156)	Y	Y					Y							Y
MCCB (IS : 13947)	Y	Y					Y			Y				
Indicating Meters (IS : 1248)	Y	Y				Y	Y			Y				Y
Indicating Lamps (IS : 13947)	Y	Y				Y	Y			Y				
Air Break Switches (IS : 13947)	Y	Y				Y	Y			Y				
Control Terminal Blocks	Y	Y				Y	Y							

LT SWITCHGEAR

(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES / CHARACTERIS-TICS → / **ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLIY** ↓	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Fuse (IS 13703)	Y	Y				Y	Y							
Control Transformer (IS : 12021)	Y	Y				Y	Y			Y				Y
Push Buttons (IS : 4794)	Y	Y				Y	Y			Y				
Transducer (IEC : 60688)	Y	Y				Y	Y			Y				Y
MCB (IS : 8828)	Y	Y				Y	Y			Y				
Breaker Handling Trolley	Y	Y				Y			Y	Y				Y
Synthetic Rubber Gasket (IS : 11149)	Y	Y		Y	Y		Y							
LT SWITCHGEAR (IS : 8623)	Y	Y				Y	Y	Y	Y	Y		Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to NTPC approval.

MODULE NO. SQE-16

CABLING, EARTHING, LIGHTNING PROTECTION

ATTRIBUTES / CHARACTERISTICS / ITEMS/COMPONENTS / SUB SYSTEMS	Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV & IR	Galvanise Test (If Applicable)	Functional	Bought out items/Bill of material	Routine tests as per relevant standard & specification	Acceptance tests as per relevant standard & specification	Constructional feature as per NTPC Specification
Wall Mounted-Lighting Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y		Y	Y	Y	Y	Y
Switch box/junction box/ Receptacles Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y
Cable glands(BS-6121)	Y													Y
Cable lug	Y													Y
Lighting wire (IS-694)	Y											Y		
Flexible conduits	Y											Y		Y
Conduits (Galvanise & Epoxy) IS-9537 & IS-2629, 2633, 6745	Y		Y						Y			Y		Y
RCC Hume Pipe (IS-458)												Y		
Cable termination & straight through joint (IS 13573)	Y											Y		Y
Cable Trays, bends, tees, crosses, Flexible supports system & accessories IS-513, 2629,2633,6745	Y		Y		Y	Y	Y		Y			Y	Y	Y
Trefoil clamp	Y													Y
GI flats for earthing & lighting protection (IS 2062, 2629, 6745,2633)	Y		Y						Y			Y		Y
GI wire (IS-280)	Y											Y		
Fire Sealing System (BS –476)												Y	Y	Y

.Note:1.This is an indicative list of tests /checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2.* Deflection Test on cable trays and Proof Load test on cable trays support system will be as per details given in the NTPC technical specification & approved MQP. The above acceptance tests shall be done only on one sample from each size of offered lot. This test is not applicable on bends, tees & crosses.

3. Make of all items will be subject to NTPC approval.

Electrical scope sheet for Scope between BHEL & Vendor- Kahalgaon ESP R&M project
(HVAC System)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V ACDB	Vendor	Vendor	Feeders for all the electrical equipment in scope of bidder shall be provided in the 415V ACDB. ACDB shall be suitable for 2 incoming supplies (125A) with suitable electrical interlock between the incomers for automatic changeover. The logical interlocks shall be built in the ACDB itself. Incoming supply to ACDB is in BHEL scope. Further distribution from ACDB to loads is in bidder's scope.
2a	Local Push Button Station (for motors)	Vendor	Vendor	Located near the motor.
2b	Local motor starters	Vendor	Vendor	Local motor starters shall be provided for all supply and exhaust fans. Local motor starters shall also be provided for fresh air fans but with additional provision for remote control from Control system.
2c	Local starter panel (for heaters, pan humidifiers)	Vendor	Vendor	This panel is required to house the contactors which are required to control the heaters and pan-humidifier. These shall be wall/skid mounted near to the heater/humidifier.

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL Vendor BHEL	BHEL Vendor BHEL	1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by BHEL except for cabling in vendor scope. 3. Termination at BHEL equipment terminals by BHEL. 4. Termination at Vendor equipment terminals by Vendor.
4	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc. Conduit for FO cables	Vendor	Vendor	
5	Cable trays, accessories & cable trays supporting system (Main route)	BHEL	BHEL	
6	Cable glands and lugs for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipment supplied by vendor 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ BHEL approval at contract stage. Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
				trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage. Conduits/tray/trough also to be provided wherever cable tray route is not available at site.
8	Lighting	BHEL	BHEL	
9	Equipment grounding & lightning protection	BHEL	BHEL	
10	Below grade grounding	BHEL	BHEL	
11	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
12	Mandatory spares	Vendor	-	Vendor to quote as per specification.
13	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
14	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
15	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
				details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.
18	Junction Boxes	Vendor	Vendor	Junction boxes shall be used to minimize/optimize the runs of cables between equipment

NOTES:

1. Make of all electrical equipment/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

1.0 INTENT OF SPECIFIATION

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

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

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

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

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

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

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

3.5 **Stress During bus Transfer**

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

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

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

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

4.0 **CONSTRUCTIONAL FEATURES**

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

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

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

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

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

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

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

4.7 **Terminals and Terminal Boxes**

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

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

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

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

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

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

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

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

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

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

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

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

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

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

	TITLE	SPECIFICATION NO.
	MOTOR	VOLUME II B
		SECTION D
	DATA SHEET - C	REV NO. 00 DATE
		SHEET 1 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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

SECTION: I

SUB-SECTION: C 4

C&I SPECIFICATION

TECHNICAL SPECIFICATION
(CONTROL AND INSTRUMENTATION)
FOR AC & VENTILATION PKG

BHEL	KAHALGAON STPS STAGE-I(4X210 MW) R&M of ESP		DESG	SK	
			CHKD	SCS	
	REV. NO. 00	DATE:16.03.2020	APPD	SCS	

INDEX

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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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
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.

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LIST OF DOCUMENTS/DELIVERABLES

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR
KAHALGAON STPS STAGE-I(4X210 MW)
R&M of ESP

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

NOTES: 1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY 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

8.11.00 **Motors**

All the motors provided shall have out put 10% higher than the equipment power required in its entire range of operation (including that of drive if any) and shall be suitable for operation at 50 deg.C ambient.

9.00.00 **CONTROL & INTERLOCKS REQUIRED**

9.01.00 Controls shall be so provided that failure of one equipment of PAC will automatically trip that PAC unit.

9.02.00 HP and LP cutout shall be provided for compressor protection. A thermostat with adjustable setting shall also be provided in the return air circuit to control the room temperature by ON-OFF mode.

9.03.00 A selector switch to enable the operation of air handling air alone or fan with cooling shall be provided.

9.04.00 Provision shall also be made for manual re-starting and stopping of the compressor.

9.05.00 Interlock shall be provided such that compressor can start only starting the air handling fan.

9.06.00 (i) In case of water-cooled condenser, one flow-switch at the outlet of each condenser shall be provided. Compressor shall not start unless the flow of water in condenser is established. Should there be no flow during operation of the plant, the flow switch shall trip the corresponding compressor motor.

(ii) In case of air-cooled condenser, interlock shall be provided so that compressor can start only if condenser fan in running. Further if the condenser fan stops, the compressor shall also trip.

9.07.00 To control the humidity throughout the year, the humidistat shall be interlocked with humidifier and reheater.

10.00.00 **PAINTING**

The cabinet shall be given chlorinated rust paint finish.

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-999-145-1056	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:	14/2/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

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	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 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

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ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
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		

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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 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	D	**			
					M	C/N					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		

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	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	D	**			
					M	C/N					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			

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ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
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		

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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:	14/4/2020	CHETAN MALIK	Checked by:	14/4/2020	KUNDAN PRASAD
Reviewed by:	14/04/2020	RK RAINA	Reviewed by:	14/4/2020	RK JAISWAL

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	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						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
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		

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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 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	*	**		
					M	C/N				D	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			
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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 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 M	6 C/N	7	8	9	D	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:	14/2/2020	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 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	D	**			
					M	C/N					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					
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:			

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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:

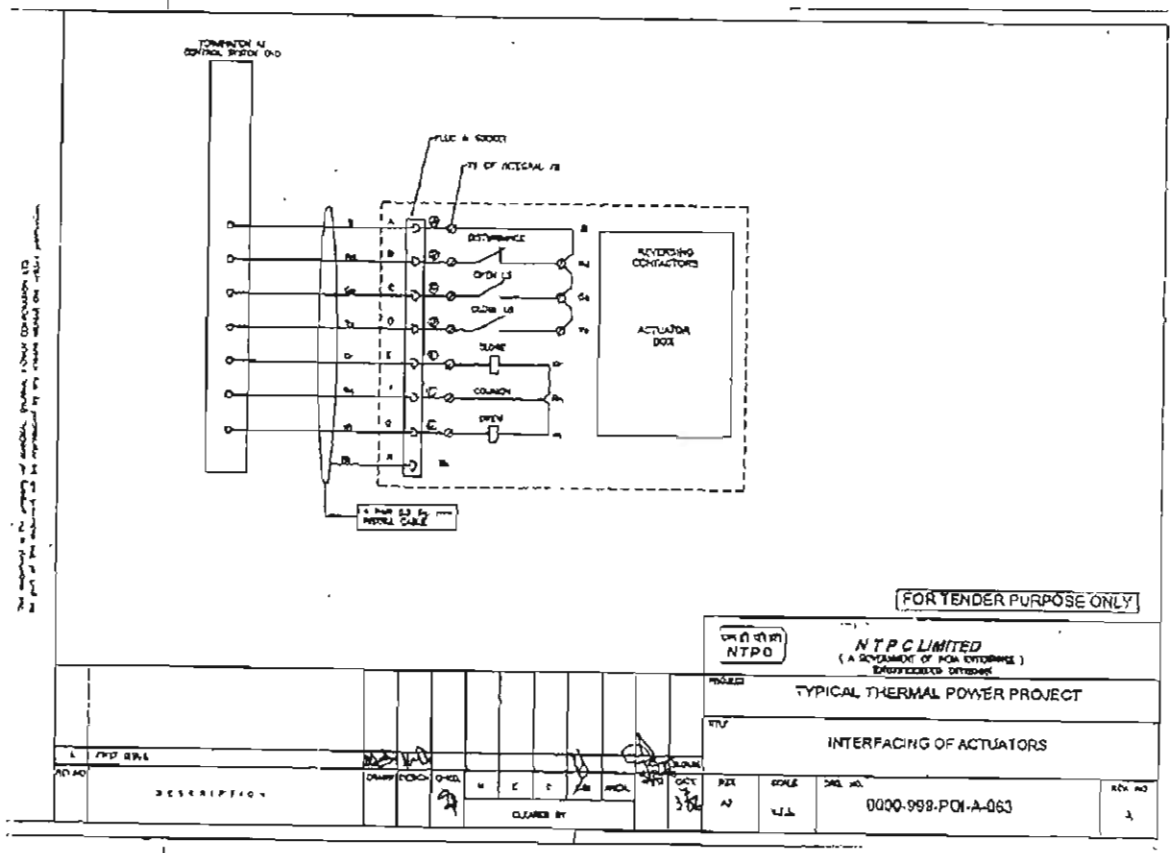
Single Phasing Protection, Over heating protection through Thermostat (as applicable) and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design Suitable means shall be provided to diagnose the type of fault locally.

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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
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.



SECTION: I

SUB-SECTION: D

STANDARD SPECIFICATION

	TITLE	SPECIFICATION NO. PE-TS-455-571-15000A-A001	
	Ventilation Fan (Axial Flow Type)	VOLUME	
	DATA SHEET - A	SECTION	
		REV 00	DATE APRIL 2015
		SHEET 1 OF 2	

No.	Particulars	Data
	General Information	
1)	Designation	Supply/Exhaust Fans.
2)	Nos. required	Refer schedule of Ventilation system in section-1A under specific technical requirement.
3)	Service	To exhaust warm air/to supply fresh air.
4)	Location	Wall mounted.
5)	Area	Same as above in 2.
	Design Data	
6)	Type supply	Axial fans suitable for 415V/3 phase for Motor.
7)	Air delivery capacity	As per schedule of ventilation system.
8)	Fluid	Atmospheric Air.
9)	Temperature	Refer Section of specific technical requirement
10)	Static Pressure required	As per specification schedule of ventilation system.
11)	Outlet Air Velocity	Not more than 12 m/sec.
	Materials	
12)	Casing	M.S.
13)	Impeller	Cast A1uminium. (Alloy A-6M,)
14)	Hub	Al Alloy.
15)	Support frame and structure.	M.S. of adequate thickness (Galvanized/ Painted).
16)	Neoprene rubber pads	As required.
17)	Coned inlet for wall exhausters/supply fans	MS
18)	Supporting frame for mounting.	Required.
19)	Protective screen at inlet.	Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh.
20)	Rain Protection Cowl	Aluminum or hot dip Galvanized after fabrication from M.S.

Motor

21)	Motor by	Bidder
22)	Starter by	BHEL

NOTE:

1) For Battery Room, motor for fan shall be of flame proof type & fan of spark proof construction with Epoxy painting.

2) Gravity type damper shall be provided at the outlet of axial fan for exhaust application.

3) Motor shall have 15% margin over Duty Point.

SECTION-D

VENTILATION FANS

1. GENERAL

This specification covers the design, manufacture, testing of performance at manufacturer's/sub-contractors works, delivery at site, handling at site, erection and commissioning of ventilation fans.

2. CODE AND STANDARDS

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where it is to be installed. The equipment shall conform to latest edition of applicable Indian Standards or their equivalent standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall conform to the latest editions of the Following standards.

2.1.1 BS:848 -Method of performance test for fans.

2.1.2 AMCA publication 99 standards handbook

2.1.3 AMCA standard 210, Test code for air moving devices.

3. DESIGN AND CONSTRUCTION

3.1 THE ENCLOSED DATA SHEET A GIVES THE NECESSARY DETAILS FOR CENTRIFUGAL/AXIAL/ROOF EXTRACTOR UNITS ETC.

3.2 WELDING PROCESS AND WELDERS EMPLOYED FOR FABRICATION SHALL BE QUALIFIED AS PER ASME SEC. IX

3.3 CASING

3.3.1 The centrifugal fans casing shall be of welded construction fabricated with heavy gauge material (min 3 mm) with flanges (min. 5 mm) on inlet and out let side for direct connection and shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed airtight. Horizontal Split casings shall be provided on large size fans. Casing drain (at bottom) with threaded plug/ with valve shall be provided, as required. All mounting/ connecting holes shall be drilled off centre.

3.3.2 The axial flow casing for supply fans/roof extractors shall be of heavy gauge construction (min 3 mm) properly reinforced for rigidity and shall be complete with suitable supports. Access doors with suitable locking arrangement shall be provided in the casing for easy access to the motor and impeller. External junction box/ Terminal box on casing with IP-55 protection shall be provided, if required. Wiring for motor from external junction box/ Terminal box shall be through flexible conduit.

3.3.3 Suitable motor brackets designed for rigid mounting of motors, shall be provided for roof extractors and wall mounted exhaust/ supply fans.

3.4 IMPELLER

3.4.1 Centrifugal fan impeller shall have die formed, aerofoil or laminar blades welded to the rim and back plate and shall have non-overloading, self cleaning characteristics. Rim shall be spun to have smooth contour. If required, intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished, if specified. The impeller, pulley and shaft sleeve shall be secured to the shaft by key and/or nuts (threaded opposite to direction of rotation of impeller). The impeller shall be statically and dynamically balanced.

~~3.4.2~~ The axial fan impeller shall be of high efficiency aerofoil design. The blades shall be mounted on a streamlined hub and the impeller shall be mounted directly on the

motor shaft. Impeller shall be in one piece however; fabricated blades will be acceptable up to 450 mm impeller diameter.

3.4.3 Roof ventilator impeller may either be centrifugal or axial type. Backward inclined blades shall be provided for centrifugal impellers. Blades may be die-formed or cast. Axial flow impeller shall be directly mounted to motor shaft whereas centrifugal impeller may either be direct-driven or belt-driven. The shaft of belt-driven centrifugal fan shall be solid cold rolled carbon steel, ground and polished. However, direct mounted impellers are preferred.

3.5 BEARINGS:

3.5.1 The centrifugal fan bearing may be ball, roller or sleeve bearings of self-aligning heavy duty type with adequate capacity and life. Make of Bearings to be specified. Bearings shall be oil/grease lubricated and provided with fittings for lubrication from outside and shall be located in easily accessible position to facilitate maintenance.

3.6 INLET CONES AND GUARDS

3.6.1 Centrifugal fans inlet shall be spun to have a smooth contour. Inlet screen, if provided, shall be galvanised wire mesh of 25 mm square with wire thickness of min. 1.5 mm.

3.6.2 Inlet cone, outlet bell and suitably designed guards shall be provided.

3.7 GUIDE VANES:

3.7.1 In case of vane axial fans guide vanes shall be provided on discharge side.

3.8 BASE PLATE AND VIBRATION ISOLATORS

3.8.1 Base plate and vibration isolators, which may be double deflection rubber in shear or rubber in compression type or spring type shall be provided. With each fan rubber bushes, washers wherever needed for vibration isolator in sufficient nos. shall be included, as required, to ensure isolation of foundation from vibration of equipment. For roof ventilators suitable mounting arrangement shall be provided such that there is no ingress of rain water into the building.

3.9 HOOD AND COWL

3.9.1 Roof exhaustors shall be provided with hinge type hood providing easy access to motor and impeller. Weather proof lockable type disconnect switch shall be provided such that hood can open only when the disconnect switch is in'off' position. On larger size of roof ventilators hoods may be of split construction. 15 mm mesh galvanised bird screen shall be provided.

3.9.2 Rain protection cowls shall be designed to suit wall exhausters/supply fans for protecting fans from rain. The cowls shall be provided with bird screen of heavy gauge expanded metal netting.

3.10 SPEED

3.10.1 The speed of axial flow fans/roof ventilators shall not exceed 960 RPM for impeller dia exceeding 450 mm and shall not be greater than 1440 with impeller dia less than 450 mm.

4. MOTORS

Drive motors shall be of totally enclosed type, suitable for horizontal/vertical mounting as applicable and shall comply with the requirements of the specifications furnished elsewhere for motors.

5. ACCESSORIES

Accessories as specified in Data sheet-A and as required for satisfactory trouble free & safe operation of fans shall be provided.

TESTING AND INSPECTION

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection by BHEL

- Visual inspection of sheets/plates, angles, channels etc. – Pitting, lamination in sheets/ plates, angles and channels shall be avoided.- visual inspection by main contractor of BHEL.
- Sheets/ Plates - Test certificate shall be furnished for physical and chemical properties for sheets / plates- for review by BHEL
- Shaft: Mechanical and chemical-– review by BHEL
- Motors (of approved make): Routine TC ,FLP TC if applicable
- Workmanship and dimensional check as per manufacturing drg. and approved Drgs.- by main contractor of BHEL.- Shall be checked by BHEL/ Customer during final inspection.
- Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked/ welded to avoid loosening. - witness by manufacturer - TC to be furnished for review by BHEL(consisting of weight of impeller, radius of correction and balancing rpm). For spare impellers Dynamic Balancing shall be witnessed by BHEL.
- Performance test of one Centrifugal fan or Axial Fan /per type/per size as per applicable standard – by BHEL.
- Centrifugal/ Axial fans 100% run tested by main contractor of BHEL. Run test by BHEL/Customer may be at random or 100%- Vibration shall be within satisfactory zone of VDI 2056 (group- G) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient

	TITLE	SPECIFCATION NO. PE-TS-455-571-15000A-A007
	LOW PRESSURE AIR DISTRIBUTION SYSTEM	VOLUME
	DATA SHEET - A	SECTION
		REV 00 / DATE APRIL 2015
		SHEET 1 OF 1

Description	**Data**
1. General (List of areas)	: As per Specification/Tender drawing.
2. GSS Duct Work a) Type	: GSS as per (Zinc coating as per Specific Technical Requirements.)
b) Size	: As per Specific Technical Requirements and bill of quantity.
3. Acoustic lining AC Outlet.	: Up to 3-5m length from Ductable Split
4. Special painting	: Galvanised.
5. Thermal Insulation	: Required in supply/ retun air duct in AC entire length.
6. Diffusers (Circular/Square) 300 mm size 350 mm size 450 mm size 550 mm size 600 mm size Any other size	: Bidder to estimate as per drawings./specification. All grille frame and louvers shall be manufactured of at least 16 SWG Aluminium
7. SA grilles (for each size)	: To suit air flow as per System requirements / Tender Drawings.
8. RA grilles (for each size)	: -do-

NOTE:

1. Duct sheet thickness shall be as per BIS/SMACNA
2. Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
3. Bidder to provide suitable gasketing at each duct flange.
4. Fire damper shall be motor operated type, when otherwise specified under Section-1A.
5. Access door in ducting system shall be provided as required.
6. MS Angle (painted) shall be used for duct supports etc.
7. Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.
8. All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.

SECTION-D

LOW PRESSURE AIR DISTRIBUTION SYSTEM

1. GENERAL

1.1 This specification covers the design, manufacture, construction features, installation, inspection testing and air balancing of air distribution system upto a total pressure of 95mm w.g. The specification is intended to cover the air distribution for air conditioning system not involving localised exhaust.

2. CODES AND STANDARDS

2.1 The design, construction and performance of complete system shall conform to all currently applicable stuatues, regulations, safety codes in the locality where the equipment are to installed

2.2 Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the SMACNA standards:-

3. MATERIAL

3.1 Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.

3.2 The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per technical requirement refer to Specific Technical Requirements.

3.3 The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work.

4. CONSTRUCTION/FABRICATION: AS PER SMACNA

4.1 DUCT SUPPORTS

Unless specified otherwise on drawings, rectangular ducts with larger side of 2250mm or above shall be supported by 15mm MS rods and 50x50x3mm and MS angles while those below 2250 mm shall be supported by 10mm MS rods and all angles shall be given a coat of primer paint. The duct supports shall be at a distance not exceeding 1800mm. The MS rods shall be fixed to MS angle cleats, which in turn are fixed to ceiling slab by suitable anchor fasteners. All anchor fasteners, MS angle cleats, coach screws, hooks and other supporting material required shall be provided by vendor.

However, If ducts are thermally insulated, the MS angles and supports shall not be in direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.

4.2 FLEXIBLE CONNECTIONS

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band 9r (or) collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

4.3 **TRANSFORMATIONS AND BREACHES**

All curves, bends, offsets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.

4.4 **CAULKING**

Wherever duct passes through wall, the opening between masonary and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.

4.5 **EASEMENT**

Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.

4.6 **ACCESS DOORS**

Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc.

All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.

4.7 **DAMPERS AND SPLITTERS**

4.7.1 Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.

4.7.2 FIRE DAMPERS

Fire dampers shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal sensor or fusible link type.

4.7.3 VANES

Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.

4.7.4 FLASHING

For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.

4.8 **DIFFUSERS AND GRILLS**

The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The

diffusers/grills shall be approved by purchaser.

Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.

4.9 **PLENUMS AND RA BOXING**

All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at appox. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonary construction to which angles are fastened.

Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box ~~shall be~~ fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.

4.10 **ACCOUSTIC LINING**

The ducts shall be lined acoustically from inside as given in data- sheet A and/or section 1A of the specification.

4.11 **PAINTING**

Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.

4.12 **THERMAL INSULATION**

Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.

5. INSPECTION AND TESTING

5.1 **INSPECTION & TESTING DURING FABRICATION**

5.1.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.

5.1.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

5.1.3 Check for dimensions & mass as per latest standard.

5.1.4 Check for defect, twists, ungalvanised spots as per latest standard.

5.1.5 Bend test & wrapping test as per latest standard.

5.1.6 Zinc coating test on samples as per latest standard.

5.2 **INSPECTION & TESTING AT SITE.**

5.2.1 The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.

5.2.2 After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.

6. BALANCING

6.1.1 The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit

6.1.2 All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.

7. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT

7.1 Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.

7.2 Test certificates in line with scope of inspection.

7.3 Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual.

SECTION-I

SUB-SECTION-E

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS

SI No.	ITEM	Sub Supplier
1	AXIAL FLOW FANS/RE UNITS	HYDERABAD POLLUTION/ SK SYSTEM / ADVANCE VENTILATION / KRUGER / NICOTRA / MARATHON / FLAKT / CB DOCTOR/ PATEL AIR /SITAL/ ICEBERG(AXIAL FAN)
2	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER /SPECTRUM / AIR TECH / PUROMATIC

एनटीपीसी NTPC	Project: KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW) Package : R&M for ESP Contractor : BHEL Contractor No. : CS-4210-104A(R&M)-2	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL ESP - MECHANICAL	DOC. NO.: CS-4130-104A(R&M)-2 REV. NO.: 0 DATE : 19.05.2017

S. N.	Item / Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commt Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approv al Status	Sub-supplier detail submission schedule	Remarks
1.	ESP Support Structures (Column, roof beam, Casing, GD Screen etc.)	I					BHEL approved sub-contractor with BHEL material		A		Welded Structure from Rolled Sections
2	CE & DE Suspension Assy. With Rapping System	III					BHEL approved Vendors		A		
3	Emitting Electrode (Discharge)	I					BHEL approved Vendors		A		
4	Collecting Electrode for ESP	I					BHEL	Ranipet	A		
5	LRB Mattress (Thermal	I					ROCKWOOL INDIA LTD,	MEDAK-AP	A		
	Insulation)						Rockwool Ind.	Bhilai	A		
							Lapinus Rockwool Ltd.	Gwalior	A		
							Goenka Rockwool	Raipur	A		
							Thermocare	Rajnandgaon	A		
							Minsulate	Jamshedpur	A		
							DHANBAD ROCKWOOL	Dhanbad	A		
							SHREERAM EQUITECH	DURG	A		
							Polybond Projects private Limited,	Durg	A		

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एनटीपीसी NTPC	Project: KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW) Package : R&M for ESP Contractor : BHEL Contractor No. : CS-4210-104A(R&M)-2	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL ESP - MECHANICAL	DOC. NO.: CS-4130-104A(R&M)-2 REV. NO.: 0 DATE : 19.05.2017

								HI-TECH ROCK FIBRE PVT.LTD	RANANDGAON	A		
6	Ducting	III						BHEL approved sub-contractor with BHEL material		A		
7	Damper	I						BHEL approved sub-contractor with BHEL material		A		
8	Gates	I						BHEL approved sub-contractor with BHEL material		A		
9	Aluminum Cladding Sheets	III						Balco India (Sterlite)		A		
								Hindalco		A		
								Indalco		A		
								Jindal		A		
10	Plates & Rolled Section	S						TISCO		A		Raw material for structural steel
								LLOYDS Steel (Uttam Value)	Wardha	A		-do
								JSPL		A		-do
								SAIL		A		-do-
								ESSAR Steel India		A		-do-
								JSW		A		-do-
								RINL		A		-do-
11	HOIST (Up to 5MT)	III						CONSOLIDATED HOISTS	PUNE	A		
								REWA INDUSTRIES	FARIDABAD	A		
								Universal Hoist	Thane	A		
								DYNAMECH CRANES	THANE , MUMBAI	A		
								CONSOLIDATED HOISTS	SATARA	A		

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एनटीपीसी NTPC	Project: KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW) Package : R&M for ESP Contractor : BHEL Contractor No. : CS-4210-104A(R&M)-2	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL ESP - MECHANICAL	DOC. NO.: CS-4130-104A(R&M)-2 REV. NO.: 0 DATE : 19.05.2017

							TRACTOR TRIFOR	FARIDABAD	A			
							ARMSEL MHE PVT LTD	BANGALORE	A			
							ANUPAM INDUSTRIES	VITHAL, UDYOGNAGAR	A			
							POWER BUILD P LTD,	V V NAGAR	A			
12	Metallic Expansion Joint	I					BHEL	Ranipet	A			
							Saravana Industries	Ranipet	DR			
							Ramana Industries	Ranipet	DR			
13	Package Air Conditioner	II					Voltas	Mumbai	A			
							Blue Star	Thane	A			
							Carrier	Gurgaon	DR			
14	Split AC (Up to 4T)	III					Daikin, Voltas, Blue Star, Hitachi, LG, Carrier, Haier		A			
15	ASH HANDLING SYSTEM (L1 LEVEL SUB-VENDOR) – SUB QR ITEM	I					INDURE	NEW DELHI	A			THE SELECTED L1 SUB-VENDOR BUT BEFORE AWARD OF L1 LEVEL SUB VENDOR BY BHEL
							MACAWBER BEEKAY	NEW DELHI	A			
							DCIPS	KOLKATA	A			
							MBE	KOLKATA	A			
							MELCO	FARIDABAD	A			
							MECGALE PNEUMATICS PVT LTD.	Nagpur	DR			
16	Structures made of built up beams	I					BHEL	Ranipet	A			

In continuation to ESP- Mechanical List

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एनटीपीसी NTPC	Project: KAHALGAON SUPER THERMAL POWER STATION STAGE –I (4 x 210 MW) Package : R&M for ESP Contractor : BHEL Contractor No. : CS-4210-104A(R&M)-2	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL ESP - MECHANICAL	DOC. NO.: CS-4130-104A(R&M)-2 REV. NO.: 0 DATE : 19.05.2017

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LEGENDS :

A - For those items proposed vendor is acceptable to NTPC, subject to meeting the NTPC Specification requirement. To be indicated with letter "A" in the list along with the condition of approval, if any.

$- Review of Mill TC for raw material to be done by NTPC and shall be included in the QP of corresponding equipment. DR – "Details required" for NTPC review.

QP INSPECTION CATEGORY :

CAT - I : For those items the Quality Plans are approved by NTPC and final acceptance will be on physical inspection witness by NTPC

CAT - II: For those items the Quality Plans are approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis of review of documents.

CAT- III: For those items main supplier approves Quality Plan. The final acceptance by NTPC shall on the basis of Certificate of Conformance by main supplier.

NTPC

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In continuation to ESP- Mechanical List

	Project	KAHALGAON–II (4 x 210 MW)	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL ESP R&M - ELECTRICAL	DOC NO.	CS-4210-104A(R&M)-2
एनटीपीसी NTPC	Package	R&M for ESP		REV. NO.	: 0
	Contractor	BHEL		DATE	: 18.05.2017
	Contractor No.	CS-4210-104A(R&M)-2			

S.No	Item Services	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commt Appl.	Status Code C/I/I	Proposed Sub Supplier	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
1	HFTR SET (Power Plus)	II					NWL	USA	A		SUB QR ITEM
		II					Kraft Powercon	Sweden	A		SUB QR ITEM
2	HVR Transformer & EC Panel	I					ADOR Powertron	Pune	A		SUB QR ITEM
		I					Hind Rectifier	Mumbai	A*		* - TO BE CONSIDERED ONLY AFTER SATISFACTORY RESOLUTION OF HVR TRF FAILURE AT FGUTPP - SUB QR ITEM
		I					BHEL	Jhansi	A		SUB QR ITEM
		I					Kraft Powercon	Pune	DR		SUB QR ITEM
3	Oil Filled LT Transformer (6.6 / .415 KV)	I					EMCO	Thane / Jalgaon	A		SUB QR ITEM
		I					VOLTAMP	Makarpura	A		SUB QR ITEM
		I					Transformer & rectifier	Ahmedabad	A		SUB QR ITEM
		I					Kanohar	Meerut	A		SUB QR ITEM
		I					Tesla	Bhopal	A		SUB QR ITEM
		I					Kirloskar Electric	Pune	A		SUB QR ITEM
		I					Andrew Yule	Chennai	A		SUB QR ITEM
		I					CGL	Malanpur	A		SUB QR ITEM
		I					ECE	Sonepat	A		SUB QR ITEM
		I					Vijay Electrical	Hyderabad	A		SUB QR ITEM
		I					Schneider	Nalni/Vadodara	A		SUB QR ITEM
		I					Sudhir Intravidyut	Bangalore	DR		SUB QR ITEM
4	LT Motor (See Note-1)	I					Jyoti	Vadodara	A		
		I					Bharat Bijlee	Mumbai	A		UPTO 160 KW,RQP
		I					CGL	Ahmednagar	A		RQP
		I					ABB	Faridabad*/ Bangalore**	A		*UPTO 55 KW**ABOVE 55& UPTO 200 KW,RQP
		I					SIEMENS	Mumbai	A		RQP
		I					NGEF	Bangalore	A		UPTO 15 KW
		I					LHP	Solapur	A		UPTO 120 KW
		I					KEC	Bangalore/Hubli*	A		*UPTO 90 KW,RQP
		I					MARATHON	Calcutta	A		RQP
5	LT MCC / ACP	I					SCHEINDER	Nasik	A		
		I					L&T	Mumbai/Coimbatore	A		
		I					C&S	Noida/Haridwar	A		
		I					UNILEC	Gurgaon	A		
		I					GEII	Bangalore	A		
		I					SIEMENS	Mumbai	A		
		I					Control Schematics	Hyderabad	A		
		I					ABB	Bangalore	DR		
6	DCDB, ACDB, MLDB, ACFB, DCFB, LIGHTING PANEL, LOCAL CONTROL PANEL, (NON PLC), PB STSTION, JB	I					Sources at Sl No. 5 are also acceptable.				For lighting transformer Refer sr no 16

एनटीपीसी NTPC	Project	KAHALGAON–II (4 x 210 MW)	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL ESP R&M - ELECTRICAL	DOC NO.	CS-4210-104A(R&M)-2
	Package	R&M for ESP		REV. NO.	: 0
	Contractor	BHEL		DATE	: 18.05.2017
	Contractor No.	CS-4210-104A(R&M)-2			

S.No	Item Services	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-missio n	Date of commt Appl.	Status Code C/M	Proposed Sub Supplier	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
		I					Pyrotech	Udaipur	A		
		I					Jackson	G. Noida	A		
		I					Control Devices	Calcutta	A		
		I					Positronics	Baroda	A		
		I					Switching Circuit	Calcutta	A		
		I					Jolly Engg	Calcutta	A		
7	LT Busduct	I					KGS Engg	Chennai	A		
		I					Spaceage	Gurgaon	A		
		I					C&S	Noida/Haridwar	A		RQP
		I					Unilec	Gurgaon	A		
		I					REEP	Chennai	A		
8	6.6 KV XLPE Power Cables	I					INCAB	Pune	A		
		I					UCL	Satna	A		
		I					KEI	Bhiwadi	A		
		I					NICCO	Shyamnagar	A		
		I					HAVELLS	Alwar	A		
		I					SHRIRAM CABLES	Bhiwadi	A		
		I					TORRENT	Nadiad	A		
		I					POLYCAB	Daman	A		
9	1.1 KV XLPE Power Cables	I					KEI	Bhiwadi	A		
		I					CORDS	Bhiwadi	A		
		I					Delton	Faridabad	A		Armoured Cables up to 3.5 X 240 SQMM .
		I					Paramount Cable	Khushkhera	A		
		I					Rallison	Bhiwadi	A		
		I					Universal Cable	Satna	A		
		I					INCAB	Pune	A		
		I					HAVELLS	Alwar	A		
		I					Radiant	Hyderabad	A		
		I					HVPL	Faridabad	A		
		I					Polycab	Daman	A		
		I					TORRENT	Nadiad	A		
		I					Nicco	Shyamnagar	A		
		I					Gemscab	Bhiwadi	A		
							KEC International	Vadodara	DR		
		I					Ravin Cable	Pune	A		
		I					Thermocables	Hyderabad	A		
		I					Suyog Cables	Vadodara	A		
		I					Sri Ram Cables	Bhiwadi	A		
		I					Sbee Cables	Bengaluru	A		
		I					Tirupati Plasematics	Jaipur	A		
		I					Advance Cable	Bengaluru	A		

एनटीपीसी NTPC	Project	KAHALGAON–II (4 x 210 MW)	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL ESP R&M - ELECTRICAL	DOC NO. CS-4210-104A(R&M)-2
	Package	R&M for ESP		REV. NO. : 0
	Contractor	BHEL		DATE : 18.05.2017
	Contractor No.	CS-4210-104A(R&M)-2		

S.No	Item Services	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-missio n	Date of commt Appl.	Status Code C/I/I	Proposed Sub Supplier	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
		I					Finolex Cable	Pune	A		
		I					Gupta Power	Bhubaneshwar	A		
							STEP Industeries	Alwar	A*		*- Subject to CHP clearance for points raised for Dariipali.
		I					Scott Innovation Wires and Cables	Baddi	A		
10	1.1 KV PVC Power Cable	I					Cords	Bhiwadi	A		
		I					Paramount	Khushkhera	A		
		I					Universal Cable	Satna	A		
		I					TORRENT	Nadiad	A		
		I					Rallison	Bhiwadi	A		
		I					Polycab	Daman	A		
		I					Nicco	Shyamnagar	A		
		I					Radiant Cable	Hyderabad	A		
		I					KEI	Bhiwadi	A		
		I					Gemscab	Bhiwadi	A		
		I					INCAB	Pune	A		
		I					HAVELLS	Alwar	A		
		I					HVPL	Faridabad	A		
		I					Delton	Faridabad	A		ARMOURED CABLE UPTO 3.6 C X 240 SQM
		I					TORRENT	Nadiad	A		
		I					INCAB	Pune	A		
							R.R. Kabla	Silvasa	DR		
							Elkay Telelink	Faridabad	DR		
							KEC International	Vadodara	DR		
		I					Ravin Cable	Pune	A		
		I					Thermocables	Hyderabad	A		
		I					Suyog Cables	Vadodara	A		
		I					Sri Ram Cables	Bhiwadi	A		
		I					Sbee Cables	Bengaluru	A		
		I					Tirupati Plasomatics	Jaipur	A		
		I					Advance Cable	Bengaluru	A		
		I					Finolex Cable	Pune	A		
		I					Gupta Power	Bhubaneshwar	A		
							STEP Industeries	Alwar	A*		*- Subject to CHP clearance for points raised for Dariipali.
		I					Scott Innovation Wires and Cables	Baddi	A		
11	1.1 KV Control Cable	I					CORDS Cable	Bhiwadi	A		
		I					HVPL	Faridabad	A		
		I					Gemscab	Bhiwadi	A		
		I					KEI	Bhiwadi	A		
		I					Radiant	Hyderabad	A		

एनटीपीसी NTPC	Project	KAHALGAON–II (4 x 210 MW)	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL ESP R&M - ELECTRICAL	DOC NO.	CS-4210-104A(R&M)-2
	Package	R&M for ESP		REV. NO.	: 0
	Contractor	BHEL		DATE	: 18.05.2017
	Contractor No.	CS-4210-104A(R&M)-2			

S.No	Item Services	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-missio n	Date of commt Appl.	Status Code C/II/I	Proposed Sub Supplier	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
		I					Rallison	Bhiwadi	A		
		I					Elkay Telelink	Faridabad	A		
		I					POLYCAB	Daman	A		
		I					NICCO	Shyamnagar	A		
		I					TORRENT	Nadiad	A		
		I					Universal Cable	Satna	A		
		I					Delton	Faridabad	A		
		I					R.R. Kable	Silvasa	A		
		I					Paramount Cable	Alwar	A		
		I					HAVELLS	Alwar	A		
		I					Gupta Power	Bhubaneshwar	A		
		I					SPM cables	Hyderabad	A		
		I					Ravin Cables	Pune	A		
		I					Suyog Cables	Vadodara	A		
		I					Incab	Pune	A		
		I					RR Kabel	Silvasa	A		
		I					Thermocables	Hyderabad	A		
		I					Tirupati Plasomatics	Jaipur	A		
		I					Advance Cable	Bengaluru	A		
		I					Finolex	Pune	A		
							KEC International	Vadodara	DR		
		I					Sbee Cables	Bengaluru	A		
							STEP Industeries	Alwar	A*		*- Subject to CHP clearance for points raised for Dadripali.
		I					Elkay Telelink	Faridabad	A		
		I					Scott Innovation Wires and Cables	Baddi	A		
12	Insulators (Bushing, Support , Shaft)	I					BHEL EPD	Bangalore	A		
13	Disconnecting Switch	IV					BHEL Approved Sources				Insulator make shall be BHEL/WS/JSV/UCE/ Aditya Birla
14	Flexible Cable Tray Supporting System	II					Steelite	Mumbai	A		SQP
		II					Inar Profiles Ltd	Ankapally	A		GALVANISING AT VISAKHA STEEL ANAKAPALLI
		II					Indiana Gratings	Pune	A		SQP,GALVANISING AT POONA GALVANISER-PUNE
		II					Vatco	Mumbai	A		SQP,GALVANISING AT SIGMA MUMBAI
		II					Amtech	Pune	A		SQP,GALVANISING AT NTPC APPROVED SOURCES
		II					Ind mark Formtech	Pune	A		
		II					Premier Power	Kolkata	A		Galvanising at NEHA
		II					Industrial Perforation	Calcutta	A		SQP
		II					Ratan	Bhagbatipur			SQP, NTPC approved galvanizing source
	Cable Tray	III					Ratan Engg	Calcutta	A		SQP,GALVANISING AT NTPC APPROVED SOURCES

एनटीपीसी NTPC	Project	KAHALGAON-II (4 x 210 MW)	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL ESP R&M - ELECTRICAL	DOC NO. CS-4210-104A(R&M)-2
	Package	R&M for ESP		REV. NO. : 0
	Contractor	BHEL		DATE : 18.05.2017
	Contractor No.	CS-4210-104A(R&M)-2		

S.No	Item Services	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-missio n	Date of commt Appl.	Status Code C/I/M	Proposed Sub Supplier	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
		III					Steelite	Mumbai	A		SQP
		III					Indiana Gratings	Pune	A		SQP,GALVANISING AT POONA GALVANISER-PUNE
		III					MJ Engg	Delhi/Bhiwadi	A		SQP
		III					India Electric Syndicate	Calcutta	A		SQP,GALVANISING AT NTPC APPROVED SOURCES
		III					Vatco	Mumbai	A		SQP,GALVANISING AT SIGMA MUMBAI
		III					Inar Profiles Ltd	Ankapally	A		GALVANISING AT VISAKHA STEEL ANAKAPALLI
		III					Jamna Metals	Delhi/Sonepl	A		SQP
		III					Indiana	Mumbai	A		SQP,GALVANISING AT KARAMTARA
		III					Techno Engg	Chandigarh	A		SQP
		III					Anad udyog	Thane	A		SQP
		III					Industrial Perforation	Calcutta	A		SQP
		III					Calcutta Mfg	Calcutta	DR		SQP
		III					Ind mark Formtech	Pune	A		
		III					Premier Power	Kolkata	A		Galvanising at NEHA
		III					AV Engg	Kokata	A		
		III					Ratan	Bhagbalpur	A		SQP, NTPC approved galvanizing source
		III					Amtech	Pune	A		SQP, Galvanizing at BG Shirke
		III					Rukmani	Raipur	A		
		III					Patny	Hyderabad	A		
		III					Unitech Fabricators & Engineers	Howrah/Hoogly (Kolkata)	A		
		III					Passive Infra	Ashsangarh (Rohtak)	A		
		III					Rabi Engg	Kokata	A		SQP, NTPC approved galvanizing source
		III					T.R.G	Chennai	A		Galvanising at TN Radhakrishna Shetty & Co
							Indiana Cable trays	Mumbai	A		Galvanizing at Karamalara
16	Lighting Transformer (Epoxy Insulated)	II					Gujarat Plug In	Vadodara	A		SQP
		II					Prayog	Pune	A		SQP
		II					Indcoil	Mumbai	A		SQP
		II					Pragati	Thane	A		SQP
		II					Southern Elect	Chennai	A		SQP
		II					Pactl	Thane	A		SQP
		II					AE	Mumbai	A		SQP
		II					KPEL	Pune	A		SQP
17	Geared Motor for ESP	III					KEC	Solapur	A		
		III					LHP	Solapur	A		
		III					New Allenbury Works	Calcutta	A		
		III					PBL	V V Nagar	A		
		III					Internal Combustion	Aurangabad	A		

एनटीपीसी NTPC	Project	KAHALGAON-II (4 x 210 MW)	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL ESP R&M - ELECTRICAL	DOC NO. CS-4210-104A(R&M)-2
	Package	R&M for ESP		REV. NO. : 0
	Contractor	BHEL		DATE : 18.05.2017
	Contractor No.	CS-4210-104A(R&M)-2		

S.No	Item Services	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commt Appl.	Status Code C/II/I	Proposed Sub Supplier	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
		III					Bongiftoi	Chennai	DR		
18	Panel Type Hopper Heater	II					HTD	USA	A		
		II					Hotfoil EHS	USA	A		
		I					HTD HEAT TRACE(I) Pvt Ltd	Hyderabad	A		
		II					Thermon	USA	A		
		I					Thermopads(Unit-II)	Hyderabad	DR		
		I					Thermon	Pune	A		
19	Tubular Type Heater	III					BHEL Approved Sources				
20	Lighting Fixtures & Luminaries	III					Wipro	Pune	A		
		III					Crompton	Mumbai	A		
		III					Phillps	Pune	A		
		III					Bajaj	Mumbai	A		
21	Welding Recepticles	III					SCHEINDER	Nasik	A		
		III					AJMERA	Mumbai	A		
		III					Best & Cropmpton	Chennai	A		
		III					BCH	Faridabad	A		
22	Lighting Wires / GI Conduit	III					BIS Licencee		A		Any make with VDE or CE or UL or CSA marking or BIS approved with valid CML number.
23	Cable Gland	III					Arup Engg	Kolkatta			Any other make with VDE or CE or UL or CSA marking or BIS approved with valid CML number.
		III					Sunil & Co	Kolkatta	A		
		III					Quality Precelsion	Kolkatta	A		
							Comet	Mumbai	A		
24	Lugs	III					Dowells	Mumbai	A		Any other make with VDE or CE or UL or CSA marking or BIS approved with valid CML number.
		III					Chetna	Nasik	A		
		III					3D	Umbergaon	A		
25	Emergency Light, Trefoil Clamps, Ceiling Fans	III					BHEL Approved Sources				
26	M.S. ROD, G.I. Flat, G.I. Wire, Earth Wire	III					BHEL Approved Sources				GALVANISING AT NTPC APPROVED SOURCES
27	Local Motor Starter Panels	III					SIEMENS	Mumbai			Any other make with VDE or CE or UL or CSA marking or BIS approved with valid CML number.
		III					L&T	Mumbai			
28	Limit Switches	III					KAKU BHILLAI	Chennai	N		Any other make with VDE or CE or UL or CSA marking or *BIS approved with valid CML number*.
		III					Jai Balaji	Chennai	N		
		III					AG System	Mumbai	N		
		III					Electromag	Mumbai	N		
		III					BCH	Faridabad	N		
29	HT Termination & Jointing Kits	III					3M	Pune	A		
		III					Raychem	Pune	A		
30	Fire sealing system - Type A Material supplier	III					3M India	Bangalore	A		
		III					GE Silicon	USA	A		

एनटीपीसी NTPC	Project	KAHALGAON-II (4 x 210 MW)	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL ESP R&M - ELECTRICAL	DOC NO.	CS-4210-104A(R&M)-2
	Package	R&M for ESP		REV. NO.	:0
	Contractor	BHEL		DATE	: 18.05.2017
	Contractor No.	CS-4210-104A(R&M)-2			

S.No	Item Services	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission n	Date of commt Appl.	Status Code C/I/I	Proposed Sub Supplier	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
		II					DOW Corning	USA	A		
31	Fire sealing system - Type B Material supplier	II					LLOYDS	Delhi	A		
		II					Signum	Nagpur	A		
		II					Vijay System Engineers Pvt Ltd	Mumbai	A		
32	Executing Agency for Fire sealing system	I					LLOYDS	Delhi	A		
		I					Signum	Nagpur	A		
		I					Vijay System Engineers Pvt Ltd	Mumbai	A		
		I					3M India	Bangalore	A		
33	FQP of electrical Equipment - (New & Replacement)	I					BHEL				
34	Interlocks for ESP	II					BHEL Approved Sources				
35	Containarised Sub-Station						To be propsed during detail Engg.				SUB QR ITEM

LEGENDS :

A - For those items proposed vendor is acceptable to NTPC, subject to meeting the NTPC Specification requirement. To be indicated with letter "A" in the list along with the condition of approval, if any. DR -- "Details required" for NTPC review. N - "NOTED"- For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with 'NOTED'.

QP INSPECTION CATEGORY :

CAT - I : For those items, the Quality Plans are approved by NTPC and final acceptance will be on physical inspection and witness by NTPC.

CAT - II: For those items, the Quality Plans are approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis of review of documents.

CAT- III: For those items main supplier approves Quality Plan. The final acceptance by NTPC shall on the basis of Certificate of Conformance by main supplier.

Note- 1 : I) For Motors less than 30 KW: Acceptance of Motor less than 30 KW is based on COC of the Manufacturer and the Contractor confirming as follows: "It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate and tested in accordance with approved drawing /data sheets".

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

Note- 2 : This is indicative list. MAKES OF ANY ITEM WHICH IS NOT INCLUDED IN THE ABOVE LIST IS SUBJECT TO NTPC APPROVAL.

Note- 3 : In case of Galvanised JB, galvanisation shall be carried out at NTPC approved sources .

Note- 4 : Electrical items of Ash handling System, if any will be tied up seperately with accepted vendor for Ash handling Package.

FORMAT NO.: QS-01-QAI-P-1/F3-R0

ENGG. DIV /QAI (S.M.THAPAR) NTPC

के. सी. गांधी परिमलम् / K. C. GANDHI PARIMALAM
उप. महाप्रबंधक / Dy. General Manager / QA
गुणवत्ता / Quality Dept.
BHEL, BAP, Ranipet - 632 406.

NTPC	PROJECT : R & M of Kahalgaon - I (2 x 210 MW)	LIST OF ITEMS REQUIRING QP	REF. NO : 4210-104A-R & M-2
	PACKAGE : R & M of Kahalgaon - Stage - I	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : M/s BHEL	VENDOR AS APPROVED BY	DATE : 19/05/2017
	CONTRACT NO : 4210-104A-R & M-2		

No.	Major Equipment	QP Inspection Category	QP No. 4210 104A-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
1	Instrument Cables (Screened)	I				Paramount	Khuskhera	A			PVC,FRLS type,SQP
		I				Polycab	Daman	A			PVC,FRLS type,SQP
		I				Delton	Faridabad	A			PVC,FRLS type,SQP
		I				KEI	Bhiwadi	A			PVC,FRLS type,SQP
		I				Elkey Telelinks	Faridabad	A			PVC,FRLS type,SQP
		I				CORDS	Bhiwadi	A			PVC,FRLS type,SQP
		I				CORDS	Kaharani	A			PVC,FRLS type,SQP
		I				Nicco	Kolkata	A			PVC,FRLS type,SQP
		I				Universal Cable	Satna	A			PVC,FRLS type,SQP
		I				Thermocables	Hyderabad	A			NTPC SQP
		I				CMI	Faridabad	A			NTPC SQP
		I				Reliance Engrs Ltd	Bengalure	DR**			
		I				Incab	Pune	DR**			
		I				Gupta Power Infra Sturcture Limited	KHURDA (Bhuveneshwar)	A			NTPC SQP
		I				Advance Cables	Bangalore	DR			
		I				TC Communications	Ghazibad	A			NTPC SQP
		I				Elkay Telelinks	Faridabad	A			PVC,FRLS type,SQP
		I				Suyog Cables	Vadodra	DR			
		I				Special Cables	Rudrapur	A			NTPC SQP
		I				Mansfield	Noida	DR			
		I				KEC International	Vadodra	DR			
2	ESP Controllers(ARECA / INTELIRAP / STATCON (As applicable)	III				BHEL Ranipathe Approved Sources		Noted			
3	IOS Panel (Without Controller)	III				BHEL-EPD	Bangalore	A			
		III				Chemin Controls	Pondicherry	A			
		III				Controls & Schematics	Hyderabad	A			
		III				Sajas Electricals	Tirchy	DR			
		III				Prammen Industeries	Pudukottai	A			
		III				Industerial Control & Appliances	Mumbai	A			

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K. C. GANDHI PARIMALAN
Dy. General Manager / QA
Quality Dept.
BHEL, BAP, Ranipet - 632 406.

NITIN GANGWAR

NTPC	PROJECT : R & M of Kahalgaon - I (2 x 210 MW)	LIST OF ITEMS REQUIRING QP	REF. NO : 4210-104A-R & M-2
	PACKAGE : R & M of Kahalgaon - Stage - I	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : M/s BHEL	VENDOR AS APPROVED BY	DATE : 19/05/2017
	CONTRACT NO : 4210-104A-R & M-2		

No.	Major Equipment	QP Inspection Category	QP No. 4210-104A-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
4	Electronic transmitters (pressure, DP & flow)	III				EMERSON (Rosemount)	USA/ Pawane	A			
		III				Fuji Electric	China	A			
		III				YOKOGAWA	Bangalore	A			EJA-E Series - 110, 430, 530
		III				ABB	FARIDABAD	A			Model - 2600 T
		III				Siemens	France / Kalwa	A			
		III				Honeywell	Pune	A			
5	Thermocouples, RTD & Thermowell	III				WIKA	Pune	A			
		III				Detriv Instrumentation & Electronics Ltd	Mumbai	A			
		III				EMERSON (Rosemount)	Pawane	A			
		III				GOA Instrument Industries	GOA	A			
		III				Minco	USA	A			
		III				OKAZAKI	JAPAN	A			
		III				Pyroelectric	Goa	A			
		III				Techno Instruments	Ahamadabad	A			
		III				Tempsens	Udaipur	A			
		III				Thermal Instruments(GIC)	Savantwadi	A			
		III				Gauges Burden	Panvel	A			
6	Ash Level indicator	III				BHEL	Ranipet	A			
		*				SBEM	Pune	DR			
		*				EIP Technologies	Noida	DR			
		II				EIP Enviro Controls	Noida	A			NTPC RQP
		II				Flow Star	Faridabad	A			NTPC RQP
		II				Nivo controls	Indore	A			
		II				Jayshree Electron	Pune	A			

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ई. सी. गांधी परिसरण
K. C. GANDHI PARIMALAN
Dy. General Manager / QA
गुणवत्ता / Quality Dept.
BHEL, BAP, Ranipet - 632 406.

NTPC	PROJECT : R & M of Kahalgaon - I (2 x 210 MW)	LIST OF ITEMS REQUIRING QP	REF. NO : 4210-104A-R & M-2
	PACKAGE : R & M of Kahalgaon - Stage - I	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : M/s BHEL	VENDOR AS APPROVED BY	DATE : 19/05/2017
	CONTRACT NO : 4210-104A-R & M-2		

No.	Major Equipment	QP Inspection Category	QP No. 4210-104A-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
7	Dust Emision Monitor (Opacity)	III				Land Combustion	UK	A			Minor Items like canopy etc manufactured in India and supplied indian Representative
		III				Durag	Germany	A			
		III				Sick Maihak	Germany	A			
		III				Emerson Process Management	Ireland	A			
		III				Codel	UK	A			Through Fobes marshell-pune Minor Items like canopy etc manufactured in india and supplied indian Representative
		II				Forbes Marshall	Pune	A			Main kit from M/s Codel, UK
8	PLC Based control system for Ash handling system	I				Forbes Marshall	Pune	A			
		I				GE Intellegent plateforms	Bangalore	A			
		I				ABB	Bangalore	A			
		I				Schneider	Nasik	A			
		I				Rockwell	Sahibabad	A			
		I				Siemens	Nasik	A			
9	PC Monitor Printer for ESP	III				BHEL Approved Vendors					
10	Any other items like PC termination box, PC Add on Cards, Simulator for Areca, Comcon interface Module etc	III				BHEL Approved Vendors					
11	FQP for C and I items covering EPMS Controller, EPMS, Ash level integator etc					BHEL					

K. C. GANDHI PARIHAR / Dy. General Manager / QA
BHEL, BAP, Ranigot - 632 406.

NTPC	PROJECT : R & M of Kahalgaon - I (2 x 210 MW)	LIST OF ITEMS REQUIRING QP	REF. NO : 4210-104A-R & M-2
	PACKAGE : R & M of Kahalgaon - Stage - I	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : M/s BHEL	VENDOR AS APPROVED BY	DATE : 19/05/2017
	CONTRACT NO : 4210-104A-R & M-2		

No.	Major Equipment	QP Inspection Category	QP No. 4210-104A-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark

LEGENDS :

1.0 SYSTEM SUPPLIER / SUB SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A - For those items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list alognwith the condition of approval, if any.
DR - For those items "Detailed Required" for NTPC review. To be identified with letter "DR" in the list.
DR '*- Proposed sub-contractor have been approved in the past but have not supplied to NTPC in last five years. . To be identified with letter "DR'*" in the list

2.0 QP INSPECTION CATEGORY :
CAT - I : For those items the Quality Plans are approved by NTPC and final acceptance will be on physical inspection witness by NTPC

CAT - II : For those items the Quality Plans are approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis of review of documents.

CAT - III : The final acceptance by NTPC shall be on the basis of Certificate of Conformance by manufacturer.

UNITS/WORKS : Place of manufacturing- Place of main supplier of multi units/works.
' - Inspection category will be decided during vendor evaluation.
NOTE - 1 : For the items not appearing in the preaward list, bidder and NTPC will mutually discussed in future.

FORMAT NO. : QS-01-QAI-P-1/F3-R0

Engg.
Div/QA&I

NITIN GANGWAR
NTPC

(GURPREET SINGH)
Deputy General Manager / QA
Quality Dept.
BHEL, BAP, Ranipet - 632 406.

ANNEXURE-II

LIST OF TOOLS & TACKLES
REFER SUGGESTIVE PRICE FORMAT

ANNEXURE-II

LIST OF MAINTENANCE TOOLS & TACKLES

FLAT D WRENCH - 6 MM TO 32 MM **(12 Pcs)**	SET	1
BOX WRENCHES - 6 MM TO 22 MM **(14 Pcs)**	SET	1
COMPLETE SETS OF RING SPANNER - 6 MM TO 32 MM **(12 Pcs)**	SET	1
ALLEN KEYS - 2 MM TO 10 MM	SET	1
CRESCENT SCREW SPANNER	NO.	1
ADJUSTABLE SPANNER	NO.	1
COMPLETE SET OF SCREW DRIVER	SET	1
OFFSET SCREW DRIVER	NO.	1
INSULATED PLIER	NO.	1
GREASE GUN	NO.	1
OIL GUN	NO.	1
LINE TESTER	NO.	1
TORCH LIGHT FOR 2 CELL	NO.	1
HAMMER 1 LB	NO.	1
OIL CAN	NO.	1
POCKET THERMOMETER - 0 TO 50 DEG. C)	NO.	1
INSULATION TAPE ROLL	NO.	1
STEEL FOOT RULE - 12"	NO.	1
FEELER GAUGE 9 BLADES	NO.	1
PIPE WRENCH	NO.	1
FLARE NUT (1/4")	NOS.	6
FLARING TOOL	NO.	1
TUBE CUTTER	NO.	1
GAS CHARGING PIPE	NO.	1
NITOGEN CHARGING ADAPTER	NO.	1
FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 0 - 300 MM PSI	NO.	1
FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 30 - 150 MM PSI	NO.	1
PSYCHRO METER	NO.	1
LOCK WITH KEY FOR TOOL BOX	NO.	1
RATCHET 1/4"	NO.	1
MS TOOL BOX	NO.	1

SECTION-I

SUB-SECTION-E

ANNEXURE-IV

MASTER DRAWING LIST WITH SCHEDULE & PROCEDURE OF SUBMISSION

SL. NO.	DESCRIPTION OF THE DRAWING/DOCUMENT	CATEGORY	SCH. WEEK (FROM DATE OF LOI)
1	TDS AND GENERAL ARRANGEMENT OF PACKAGE AC UNITS	Approval	2
2	TDS & GENERAL ARRANGEMENT OF VENTILATION FANS	Approval	2
3	GA OF DISTRIBUTION PANEL/BOARD	Approval	2
4	LAYOUT OF AC IN CONTROL ROOM	Approval	3
5	LAYOUT OF VENTILATION FANS IN SWITCHGEAR ROOMS	Approval	3
6	INSTALLATION, OPERATION & MAINTENANCE MANUAL	Information	3
7	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	Information	3
8	EQUIPMENT MOUNTING DRAWING	Information	4
9	QUALITY ASSURANCE PLAN	Approval	3
10	CONTROL AND OPERATION WRITE-UP OF AC SYSTEM	Approval	4
11	INSPECION AND TESTING WITH STANDARD QUALITY PLAN	Approval	2
12	VENDOR LIST	Approval	4
13	PAINTING SCHEDULE	Approval	2
14	COMPLETE CONTROL SYSTEM FOR AC & VENTILATION	Approval	4
15	CONTROL SCHEME/ LOGIC DIAGRAM	Approval	4
16	INSTRUMENT SCHEDULE WITH SET POINT	Approval	4
17	I/O LIST(ANALOG & BINARY)	Approval	4
18	DRIVE LIST/ SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA(IF APPLICABLE)	Approval	4
19	FIELD JB/ LIE/ LIR, DRIVE TERMINATION	Approval	4
20	DATA SHEET FOR INSTRUMENTS, JB ETC.	Approval	4
21	QUALITY PLANS (INSTRUMENTS, LCP ETC.)	Approval	4

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering

stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.

a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Drawings/ documents to be submitted for purchaser's review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 …. etc.

f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

i) 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.

j) Bidder to follow the following the drawing submission schedule:

k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 7 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

SECTION-I

SUB-SECTION-E

ANNEXURE-IV

LIST OF MANDATORY SPARES

LIST OF MANDATORY SPARES

NAME OF PROJECT:		**4X210 MW ESP CONTROL ROOM - R&M-NTPC**	
NAME OF PACKAGE:		**HVAC SYSTEM**	
TECHNICAL SPECIFICATION No:		**PE-TS-455-571-15000A-A001**	
S. No.	**Description**	**UNIT**	**Qty**
A	**HVAC SYSTEM**		
1	**Electrical Actuators**		
1.1	Actuators	1 no. of each type, class, size and model whichever is more.	
1.2	Control/selector switch	5 nos. of each type and rating	
1.3	Control fuses	5 nos. of each type and rating	
1.4	Neutral link	2 nos.	
1.5	Vertical busbar dropper support insulator	3 nos.	
1.6	Power fuses	12 nos. (equally divided for all ratings)	
1.7	Each type of contactor	2 nos.	
1.8	Contactor coil of each type and rating	3 nos.	
1.9	Indication Lamps	5 nos.	
1.10	Each type of push button	10 nos.	
1.11	Indicating lamp holders complete	10 nos. (equally divided for all ratings)	
1.12	Terminal blocks of each type and rating	12 nos.	
1.13	Horizontal busbar support insulator	2 nos.	
2	**Control Panels**		
2.1	Control supply transformer (if any)	1 no. of each type and rating	
2.2	Relays and timers	1 no. of each type and rating	
2.3	Contactors	1 no. of each type and rating	
2.4	LEDs	5 no. of each type and rating	
2.5	Control switches	1 no. of each type	
2.6	Selector switches	1 no. of each type	
2.7	Push buttons	2 nos. of each type and colour	
2.8	Any special meters	1 no. of each type	
3	**Control & Instrumentation**		
3.1	Process Actuated Switch Devices		
3.1.1	Includes all types of Pressure, differential pressure, flow, temperature, level switch Devices.	10% or 1 no. of each type and model whichever is more	

Notes:

a) Spares listed in Price Schedule is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification aprat from specified above, same shall be deemed to have been covered in bidder's scope of supply.

b) Wherever 'set' is indicated, it shall mean complete replacement for one main equipment.

c) "Total Population" as mentioned in the table, refers to the total population of the corresponding item as installed for all the units.

d) Quantity mentioned in percentage (%) is the % of total installed.

e) If percentage comes as fraction next higher integer should be considered for the purpose of quantity required.

f) All Spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is "not applicable" for

g) Any item which is quoted as "not applicable" by the bidder in the above list and is found to be "applicable" at a later date shall be supplied by

h) Any cell left blank in the unpriced schedule shall be treated as "Quoted" and is included in total price.

#

SECTION II

SECTION-II

SUB-SECTION-1

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.

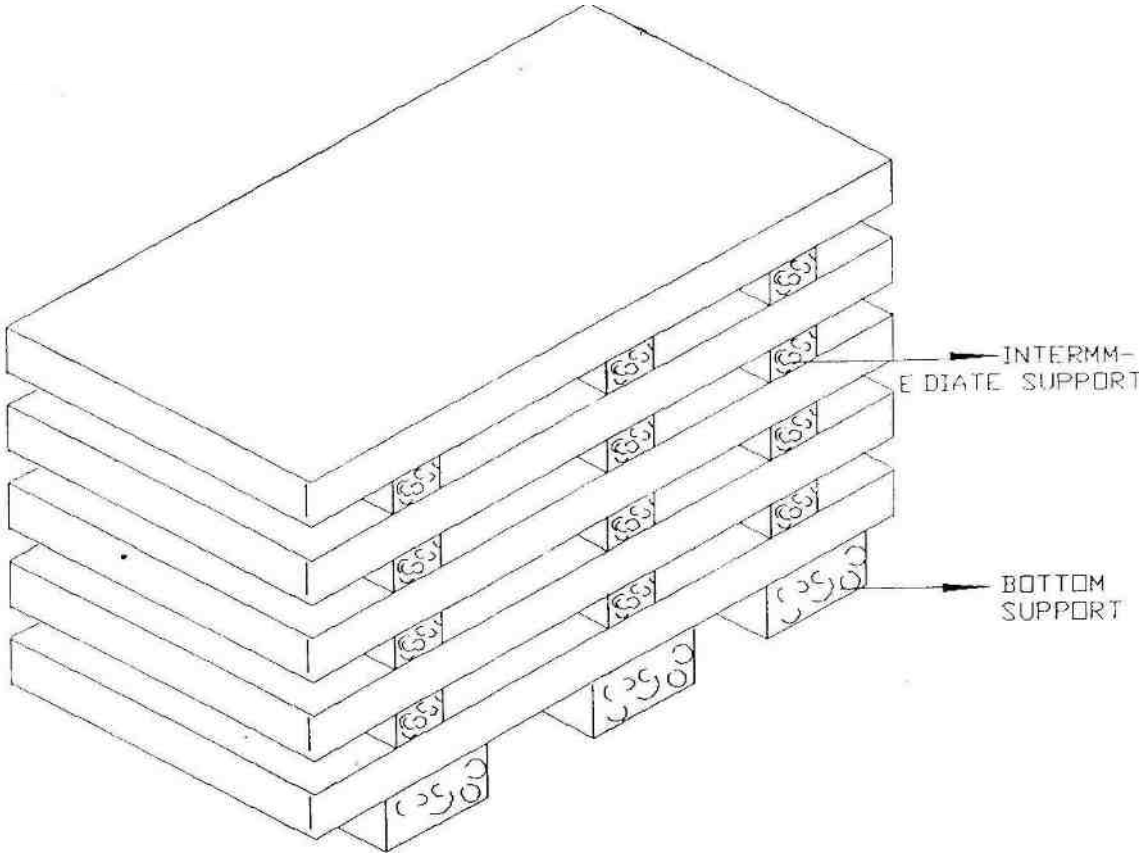


Figure – 1 – PLATE STACKING ARRANGEMENT

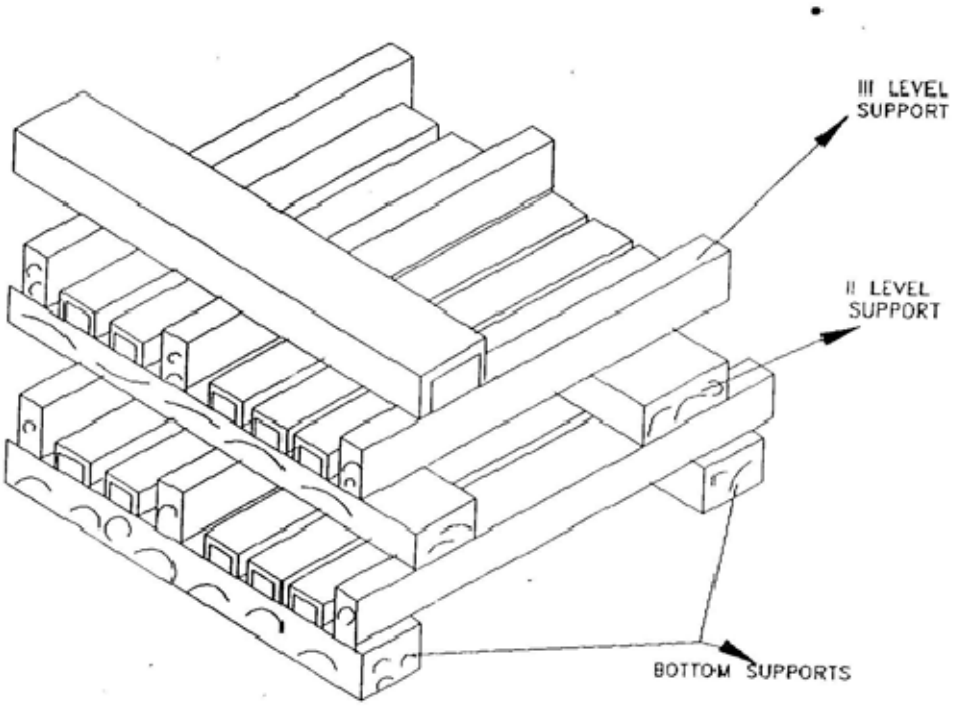


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

SECTION-II

SUB-SECTION-2

INSPECTION AND TESTING, WITH STANDARD QUALITY PLAN

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 equipments 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 equipment must be held at this stage until the Owner has inspected the same, 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 internal 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 for approval.

For electrical equipment, routine tests as per relevant IS standard 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 Purchaser. 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(s) 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 magnaflux 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/Demonstration 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(s), refer to respective section of this specification.

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

NOTE: Project's specific requirement of inspection and testing shall be furnished in QAP as per the format on the following page for the approval of BHEL/BHEL's Customer.

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 shall submit the signed and stamped copy of the following documents along with the bid:

1. Compliance cum confirmation certificate
2. Un priced format for main package including Commissioning spares and Tools & Tackles (mentioning 'quoted' against each item)
3. Deviation schedule /No deviation certificate in attached format 'Deviation sheet (Cost of withdrawal)'.
4. Pre-bid clarification schedule, if any.

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish the same along 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 QAP 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) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specification. 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.

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

k) 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; same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

l) 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.

m) 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.

n) 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.

o) All technical deviations (if any) have been indicated in technical deviation schedule. Any commercial deviation/ document shall not be considered during technical evaluation. However if any issue in the commercial documents / deviation related to technical requirements needs to be highlighted and resolve in technical evaluation only. No aspect of commercial issues needs to be highlighted / resolved in technical evaluation and their offer is strictly in compliance with technical specification. Any technical deviations (e.g. related to MDL, required documentation etc. for completion of the project) raised by them in commercial deviation either explicit or implicit shall be considered null and void even if agreed by BHEL during commercial evaluation stage. Bidder agreed to confirm and compliance with technical specification and subsequent clarification on bids during pre- award discussion.

PRE-BID CLARIFICATION SCHEDULE

SL. 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: _____

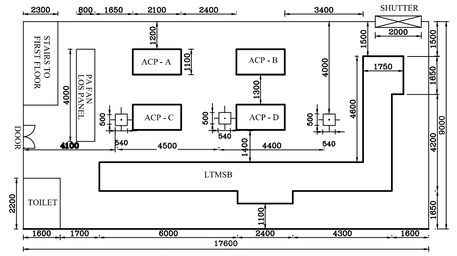
Date: _____

Company Seal

DEVIATION SHEET (COST OF WITHDRAWAL)
Refer relevant clause of GCC

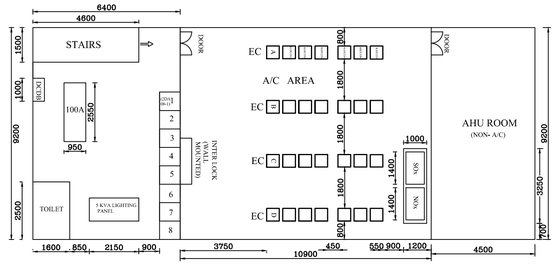
The following drawings are enclosed for the reference of bidder:

	Drawing Title / Number:
a	BHEL Drg No. 1-00-114-29273
b	BHEL Drg No. 0-00-111-27611
c	BHEL Drg No. SCHEME OF AIR CONDITIONING SYSTEM – PE-DG-455-571-15000A-A001

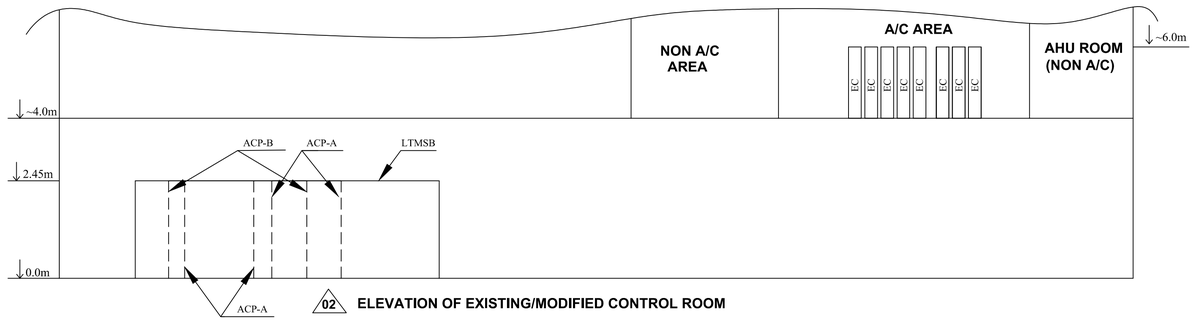


EXISTING CONTROL ROOM
LAYOUT FOR GROUND FLOOR(NON A/C AREA)

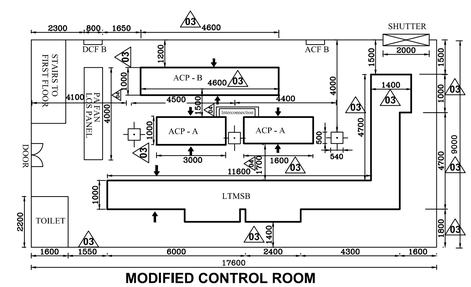
02 EXISTING ACP-DOUBLE FRONT
EXISTING LTMSB-SINGLE FRONT



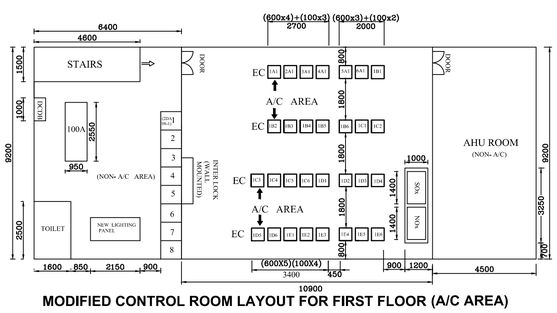
EXISTING CONTROL ROOM LAYOUT FOR FIRST FLOOR(A/C AREA)



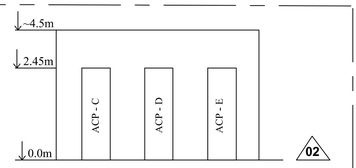
02 **ELEVATION OF EXISTING/MODIFIED CONTROL ROOM**



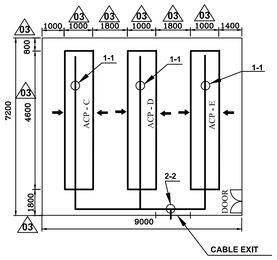
MODIFIED CONTROL ROOM
LAYOUT FOR GROUND FLOOR(NON A/C AREA)



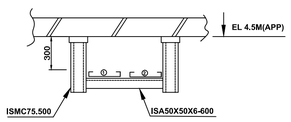
MODIFIED CONTROL ROOM LAYOUT FOR FIRST FLOOR (A/C AREA)



02 **ELEVATION OF CONTAINERISED CONTROL ROOM**

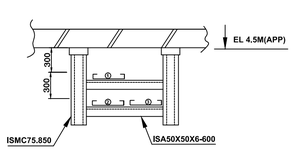


CONTAINERISED CONTROL ROOM-PLAN



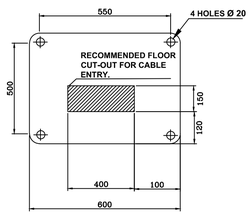
DETAIL 1-1

1. 300 LTCT – INCOMING & OUTGOING POWER CABLES FOR ACP.
2. 150 LTCT – OUTGOING CONTROL CABLES FOR ACP.



DETAIL 2-2

1. 300 LTCT – INCOMING POWER CABLES TO ACP.
2. 300 LTCT – OUTGOING POWER CABLES FROM ACP.
3. 150 LTCT – OUTGOING CONTROL CABLES FROM ACP.



FOUNDATION PLAN FOR ELECTRONIC CONTROLLER (EC)

01

ALL DIMENSIONS ARE IN MILLIMETRES

NOTE :

01. EXISTING SERVICE TRANSFORMER(1.6 MVA 2 NOS) AND BUS DUCTS TO BE REPLACED WITH 2NOS. 2.5MVA. SERVICE TRANSFORMER & NEW LT BUS DUCT BY RMSG,BHOPAL.
02. MODIFICATION OF EXISTING CONTROL ROOM(IF REQUIRED) IS IN BHEL–RMSG BHOPAL/PSER SCOPE.
03. EXISTING LT MAIN SWITCHBOARD WILL BE REMOVED & REPLACED BY NEW LTMSB. THIS NEW LTMSB WILL CATER POWER TO MODIFIED ESP A TO D & NEW ESP–E.
04. EXISTING ACP A,B,C,D WILL BE REMOVED. NEW ACP–B WILL BE PLACED IN THE EXISTING LOCATION OF ACP A,B. NEW ACP–A WILL BE PLACED IN THE EXISTNG LOCATION OF ACP C,D.
05. NEW ACP FOR MODIFIED ESP C,D AND NEW ESP–E WILL BE PLACED IN CONTAINERISED CONTROL ROOM.
06. NEW EC PANELS MEANT FOR MODIFIED ESP & NEW ESP WILL BE PLACED BY REMOVING THE EXISTING EC PANELS AVAILABLE IN THE FIRST FLOOR.
07. EXISTING LAYOUT & MODIFIED LAYOUT BOTH ARE SHOWN IN THE DRG.
08. ARECA–II IS SUPPLIED FOR MODIFIED ESP & NEW ESP. HENCE RCP PANEL IS NOT APPLICABLE.
09. ALL EC PANELS ARE PROVIDED WITH BOTTOM ENTRY FOR CABLES.ACP SHALL BE PROVIDED WITH TOP ENTRY FOR CABLES.LTMSB PANELS ARE PROVIDED WITH BUS DUCT, TOP ENTRY. ACP & LTMSB SUPPLIED WILL HAVE FORM IVB DESIGN OF 900MM WIDTH.
10. HEAT LOSS/PANEL : EC – 0.2KW/PANEL (APPROX.)
ACP – 5.0KW/PANEL (APPROX.)
LTMSB–10.0KW/PANEL(APPROX.)
11. THE CABLE TRAY EXIT SHALL BE SEALED PROPERLY SO THAT RAIN WATER AND DUST SHALL NOT ENTER INSIDE THE ROOM/TRENCH.
12. ALL KINDS OF CIVIL WORKS INVOLVED FOR OLD PANEL REMOVAL,HANDLING & NEW PANEL ERECTION, COMMISSIONING ETC SHALL BE DONE BY BHEL IN CONSULTATION WITH NTPC SITE ENGINEER.
13. MENTIONED DIMENSIONS ARE CLEAR DIMENSIONS FROM WALL/COLUMN EDGE.
03 14. WEIGHT OF THE PANELS: EC=300 KG.(APPROX); LTMSB=14000 KG/PANEL, ACP=3700 KG/PANEL.
15. LOCATIONOF DOORS/SHUTTER SHOWN FOR EXISTING CONTROL ROOM ARE EXISTING LOCATION, NEW LOCATION IF REQUIRED SHALL BE DECIDED SUITABLY BY RMSG/PSER IN CONSULTATION WITH NTPC.
16. LOCATION OF DOORS/SHUTTER SHOWN FOR CONTAINERISED CONTROL ROOM SHALL BE DECIDED SUITABLY IN CONSULTATION WITH NTPC.
17. EXISTING FALSE CEILING SHALL BE RETAINED IN EXISTING ESP CONTROL ROOM.
18. FOR LOCATION OF 2.5MVA ESP SERVICE TRANSFORMER, DRG.NO: 4210–104A–01–PVM–002 SHALL BE REFERRED.
01 19. FOR LOCATION OF CONTAINERISED CONTROL ROOM, DRG.NO: 4210–104A–01–PVM–002 SHALL BE REFERRED.

LEGEND :

EC – ELECTRONIC CONTROLLER (600X550X2000)
03 LTMSB – LTMSB PANEL (DOUBLE FRONT DRAW TYPE) [(11600MM+4700MM) X 1000MM/1400MM X 2450MM)]
03 ACP – ACP PANEL PANEL (DOUBLE FRONT TYPE) (4600 MM X 1000MM X 2450MM)
↑ – FRONT SIDE OF THE PANEL

DCFB –DC FUSE BOARD (WALL MOUNTED) 800(L)X800(H)X200(D)
ACFB –AC FUSE BOARD (WALL MOUNTED) 800(L)X800(H)X200(D)
NEW LIGHTING TRANFORMER PANEL=2000(L)X1500(D)X2300(H).

JOB NO.				
STATUS	CONTRACT			
DISTRIBUTION				
TO				
NO.OF				
REV	DATE	ALTD	CHD	APPD
03	11.09.18			

REVISED TO INDICATE FINAL DIMENSIONS OF ACP&LTMSB

JOB NO.				
STATUS	CONTRACT			
DISTRIBUTION				
TO				
NO.OF				
REV	DATE	ALTD	CHD	APPD
02	20.08.18			

REVISED AS PER NTPC LETTER DATED 16–08–18

JOB NO.				
STATUS	CONTRACT			
DISTRIBUTION				
TO				
NO.OF				
REV	DATE	ALTD	CHD	APPD
04	03.10.18			

REVISED AS PER NTPC LETTER DATED 03–10–18

JOB NO.				
STATUS	CONTRACT			
DISTRIBUTION				
TO				
NO.OF				
REV	DATE	ALTD	CHD	APPD
01	02.08.18			

REVISED AS PER NTPC LETTER DATED 03–08–18

CUST NO: R4S5,R4S6,R4S7&R4S8

NTPC DRG.NO. 4210–104A–01–PVM–044

TYPE OF PRODUCT OR NAME OF PROJECT: NTPC LTD, KAHALGAON THERMAL POWER PROJECT (4X210 MW)

BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET: 632 406.

DEPT CODE: M

	NAME	SIGN	DATE
DRN	J.INDUMATHI		13.07.18
DESN	R.V		14.07.18
CHD	R.V		14.07.18
APPD	M.J.M		14.07.18

TITLE: RECOMMENDED LAYOUT(EXISTNG & NEW) OF ESP CONTROL ROOM,CONTAINERISED CONTROL ROOM.

BHEL/BAP DRG.NO. 1–00–114–29273

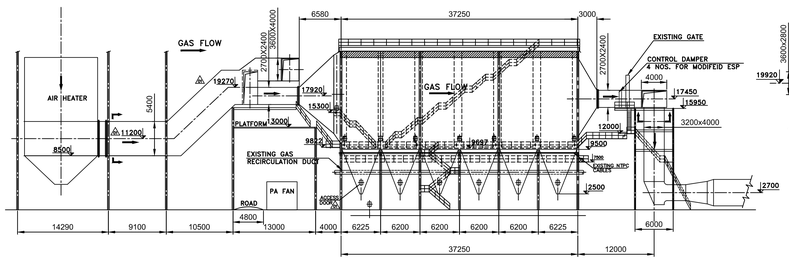
SCALE : N.T.S

SHEET 01 OF 01 REV 04

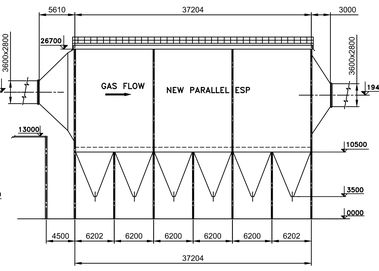
Size A1

DRAWING NO. 0-00-111-27611

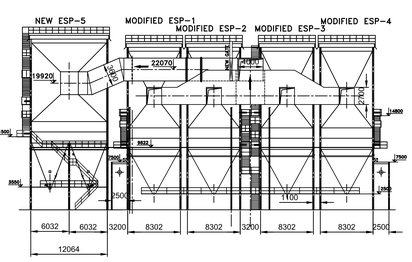
ALL DIMENSIONS ARE IN MILLIMETRES



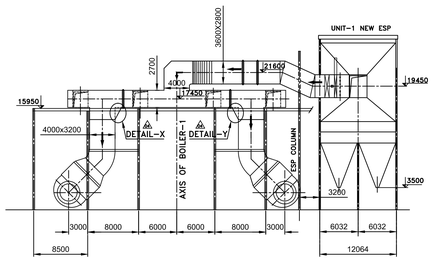
MODIFIED ESP–ELEVATION–AA



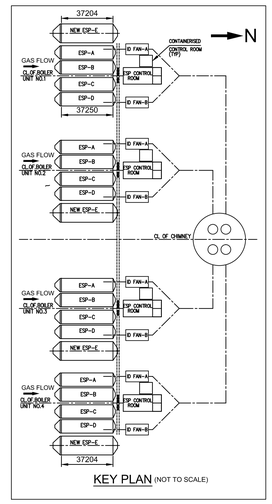
NEW PARALLEL ESP ELEVATION–BB

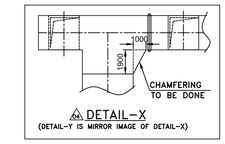


ESP INLET SIDE VIEW–CC FOR UNIT–1

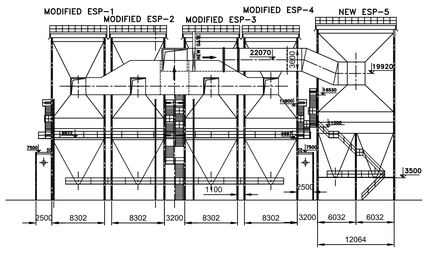


ESP OUTLET SIDE VIEW–EE FOR UNIT–1

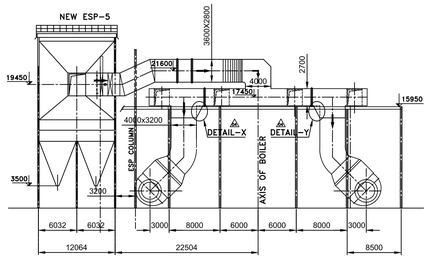




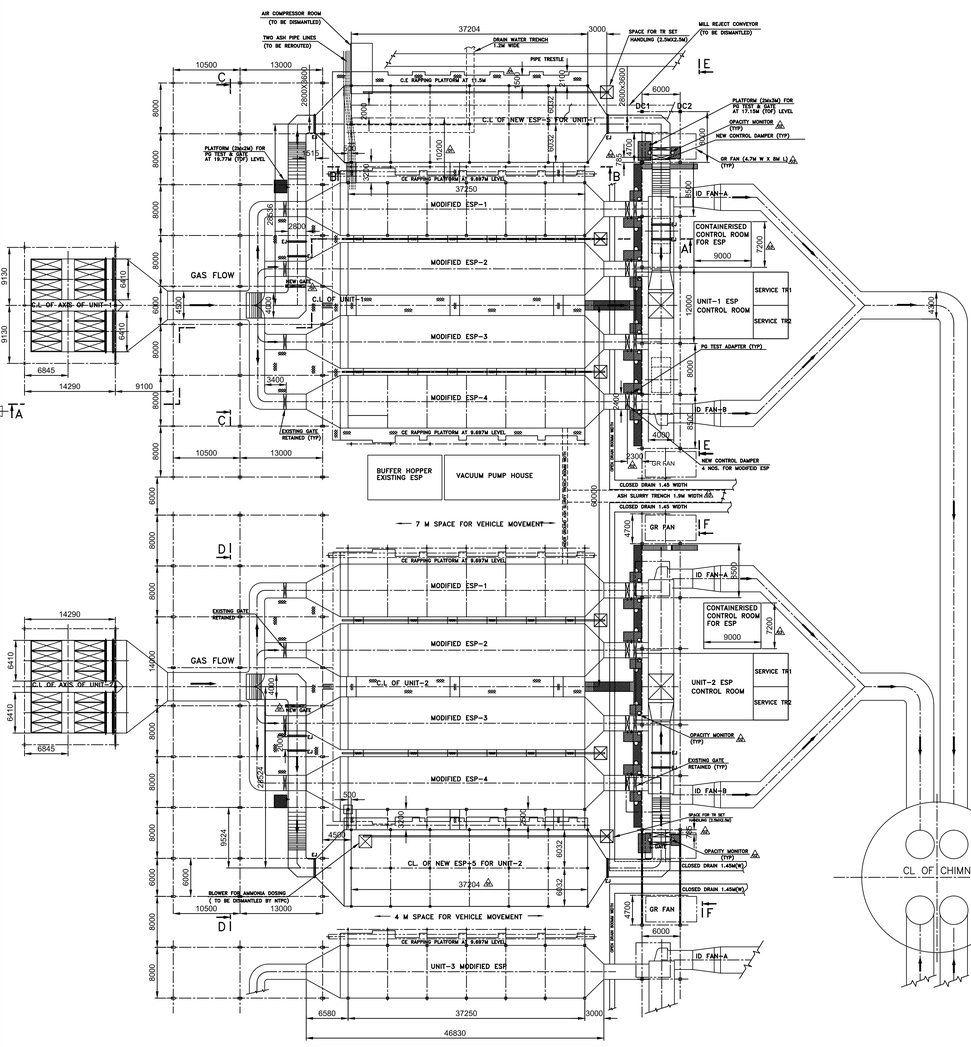
⚠ DETAIL–X
(DETAIL–Y IS MIRROR IMAGE OF DETAIL–X)



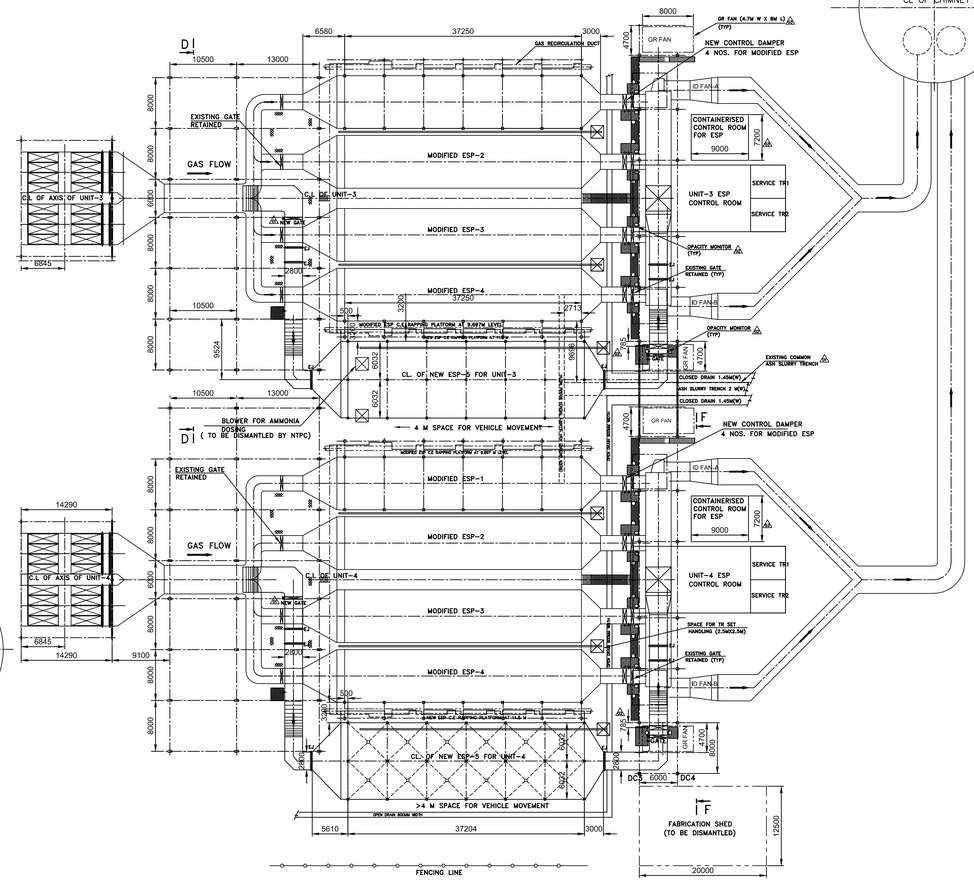
ESP INLET SIDE VIEW–DD FOR UNIT–2,3,4



ESP OUTLET SIDE VIEW–FF FOR UNIT–2,3,4



PLAN VIEW FOR UNIT–1&2



PLAN VIEW FOR UNIT–3&4

NOTES:

01. EXISTING ESP SIZE: 4 NOS. FAA–6X45H–78125–2 MODIFIED AS ESP SIZE: FAA–6X45M–76150–2 NO. OF MODIFIED ESP PER BOILER: 4.
NEW ESP SIZE: FAA–6X45M–116150–2; NO. OF NEW ESP PER BOILER: ONE
BOB – BOTTOM OF BASE PLATE.
TOF – TOP OF FLOOR GRILL.
✚ INDICATES NEW ESP COLUMN
DC1,DC2,DC3,DC4 INDICATES NEW ESP DUCT SUPPORT COLUMN
INDICATES ESP TERMINAL POINTS AND SCOPE OF SUPPLY.

02. 0000 LEVEL REFERS TO RL +35M WHICH CORRESPONDS TO BOB OF EXISTING ESP COLUMN.

03. METHOD OF ESP RENOVATION & RETROFITTING ARE DESCRIBED BELOW;

A. EXISTING ESP IS MODIFIED AS BELOW;.
EXISTING ESP INTERNALS WILL BE REPLACED WITH NEW DESIGN INTERNALS OF 400 MM PITCH, 15 M FIELD HEIGHT, 4.5 M FIELD LENGTH. NO. OF FIELDS IN SERIES WILL BE SIX.
THE ESP CASING WILL BE EXTENDED VERTICALLY TO ACCOMMODATE 15 M FIELD HEIGHT.
ESP INLET AND OUTLET FUNNELS WILL BE REPLACED.
ESP PENT HOUSE WILL BE DISMANTLED AND LOCAL CANOPY WILL BE PROVIDED OVER TR SET ON ROOF. REPAIR OF EXISTING ESP CASING, HOPPERS WILL BE CARRIED OUT BASED ON ASSESSMENT.

B. NEW ESP WILL BE LOCATED IN PARALLEL TO EXISTING ESP AS SHOWN IN THIS LAYOUT DRAWING.
INLET DUCT TO NEW ESP WILL BE TAPPED FROM INTERSECTION OF APH OUTLET DUCT & ESP INLET COMMON BUS DUCT AS SHOWN IN THE LAYOUT DRAWING.
OUTLET DUCT OF NEW ESP WILL BE CONNECTED AT MIDDLE OF THE EXISTING ID FAN COMMON BUS DUCT AS SHOWN IN THE LAYOUT DRAWING.

C. THE EXISTING DUCT FROM APH OUTLET TO ID FAN INLET WITH IN TERMINAL POINTS ARE RETAINED. DUCT REPAIR WORK AND DUCT INSULATION REPLACEMENT WILL BE CARRIED OUT BASED ON ASSESSMENT.
SUPPLY OF INSULATION 100MM THICK LRB MINERAL WOOL, CLADDING SHEET 0.71 MM THICK FOR 3500 SQ.M PER UNIT CONSIDERED FOR EXISTING DUCT INSULATION AS PER CONTRACT.
SUPPLY OF 6 MM MS PLATE & STRUCTURAL MATERIAL 40 MT PER UNIT IS CONSIDERED FOR REPAIR WORK OF EXISTING DUCT, ESP CASING, HOPPERS AS PER CONTRACT.
EXISTING DAMPERS AT ESP INLET AND OUTLET DUCT IN UNIT–1&3 AND GATES IN UNIT–2&4 WILL BE RETAINED. NEW GATE AT NEW ESP INLET AND OUTLET DUCT, CONTROL DAMPERS (MOTORISED) AT MODIFIED ESP OUTLET DUCT/NEW ESP OUTLET DUCT WILL BE PROVIDED.

04. INTERFERENCES OF EXISTING FACILITIES (ABOVE GROUND) FOR LOCATING NEW PARALLEL ESP & ITS DUCTING ARE GIVEN BELOW;
TO BE DISMANTLED:
– MILL REJECT CONVEYOR AT L.H.S OF UNIT–1 ESP TO BE DISMANTLED .
– AIR COMPRESSOR ROOM NEAR MILL REJECT CONVEYOR TO BE DISMANTLED.
– BLOWER FOR AMMONIA DOSING SYSTEM, OF UNIT–2 & 3 ESP TO BE DISMANTLED BY NTPC.
– ID FAN IMPELLER AT R.H.S OF UNIT–2 ESP TO BE DISMANTLED BY NTPC.
TO BE REROUTED:
– TWO NO. ASH PIPE LINES AT GROUND LEVEL IN UNIT–1 EXISTING ESP 1ST ROW COLUMN L.H.S.

05. EXISTING ESP CONTROL ROOM IS RETAINED TO HOUSE ONE NO. LT BOARD, TWO NO. ACP, EC PANELS OF MODIFIED ESP AND NEW ESP.
NEW CONTAINERIZED CONTROL ROOM IS PROVIDED TO HOUSE 03 NO. ACP PANELS INCLUDING NEW ESP ACP PANEL.

06. EXISTING ESP STAIR CASE TO BE SUITABLY EXTENDED TO G.D RAPPING MOTOR, .CE RAPPING DRIVE EXISTING C.E PLATFORM TO BE RELOCATED AS PER ARRANGEMENT SHOWN IN ELEVATION VIEW OF MODIFIED ESP.

07. INSULATION & CLADDING FOR NEW ESP & ITS DUCTING AND EXTENDED PORTION OF MODIFIED ESP, FUNNEL WILL BE 75 MM THICK LRB MINERAL WOOL AND CLADDING SHEET PLAIN ALUMINUM SHEET 0.71 MM THICK.
EXISTING DUCT INSULATION & CLADDING WILL BE REPLACED WITH 100 MM THICK LRB MINERAL WOOL AND CLADDING PLAIN ALUMINUM SHEET 0.71MM THICK BASED ON ASSESSMENT.

⚠ 08. OPACITY MONITOR ONE EACH AT ESP OUTLET DUCT (TOTAL 5 NOS. PER BOILER) WILL BE SUPPLIED AND MARKED IN THIS DRAWING.

09. LAYOUT OF ESP & DUCTING DRAWING SHOWN IN THIS DRAWING IS FOR UNIT NO. 1 TO 4.

10. REFER DRG. NO.1–00–111–29164. (NTPC DRG. NO.4210–104A–01–PVM–001 SH 01 OF 02) FOR MODIFIED ESP G.A DRAWING

11. REFER DRG. NO.1–00–111–29165. (NTPC DRG. NO.4210–104A–01–PVM–001 SH 02 OF 02) FOR NEW ESP G.A DRAWING.

⚠ 12. CHAMFERING TO BE DONE ON ONE SIDE OF ID FAN SUCTION DUCT TO WIDEN THE DUCT OPENING TO ACCOMMODATE ADDITIONAL FLOW FROM NEW ESP TO ENSURE SMOOTH & UNIFORM FLOW.

REV	DATE	ALTERED/ CHECKED	REMARKS
04	31.07.2019	ALTERED: MRC/MADHU CHECKED: M.RAVICHANDRAN	CHAMFERING TO BE DONE ON ONE SIDE OF ID FAN SUCTION DUCT TO WIDEN THE DUCT OPENING TO ACCOMMODATE ADDITIONAL FLOW FROM NEW ESP AND TO ENSURE SMOOTH & UNIFORM FLOW. DRAWING UPDATED.
03	25.04.2018	ALTERED: MRC/MADHU CHECKED: M.RAVICHANDRAN	CONTAINERISED CONTROL ROOM DIMENSION REVISED AS PER TCM MOM 07.20.04.18 ASH SLURRY TRENCH BETWEEN UNIT–1&2 MARKED. GR FAN LOCATION W.R.T COLUMN MARKED. DRAWING UPDATED.
02	23.03.2018	ALTERED: MRC/MADHU CHECKED: M.RAVICHANDRAN	CONTROL DAMPER LOCATION MARKED AT NEW ESP OUTLET DUCT. OPACITY MONITOR LOCATION MARKED AT NEW ESP OUTLET DUCT. OPACITY MONITOR LOCATION MARKED AT MODIFIED ESP OUTLET DUCT. NOTE HOLDS ADDED DRAWING UPDATED.
01	03.03.2018	ALTERED: MRC/MADHU CHECKED: M.RAVICHANDRAN	APH OUTLET DUCT SIZE, ELEVATION MARKED. GATE LOCATION AT ESP INLET DUCT REVISED. DRAWING UPDATED.

CUSTOMER NO. R4S5, R4S6, R4S7 & R4S8

NTPC DRG NO: 4210–104A–01–PVM–002

CUSTOMER: NTPC LIMITED
PROJECT: KAHALGAON STPS STAGE–I (4X210MW), RENOVATION & RETROFITTING OF ELECTROSTATIC PRECIPITATOR PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED
UNIT: BOILER AUXILIARIES PLANT, RAMPET-502 406.

DEPT CODE	NAME	SIGN	DATE
DRN	K.MADHU		09.01.18
M CHD	M.RAVICHANDRAN		09.01.18
APPD	S.S.MANI		09.01.18

TITLE: PLOT PLAN AND LAYOUT OF ESP & DUCTING FOR ST–I

SCALE: 1:350

BHEL DRAWING NO. 0–00–111–27611

REV. NO. 04

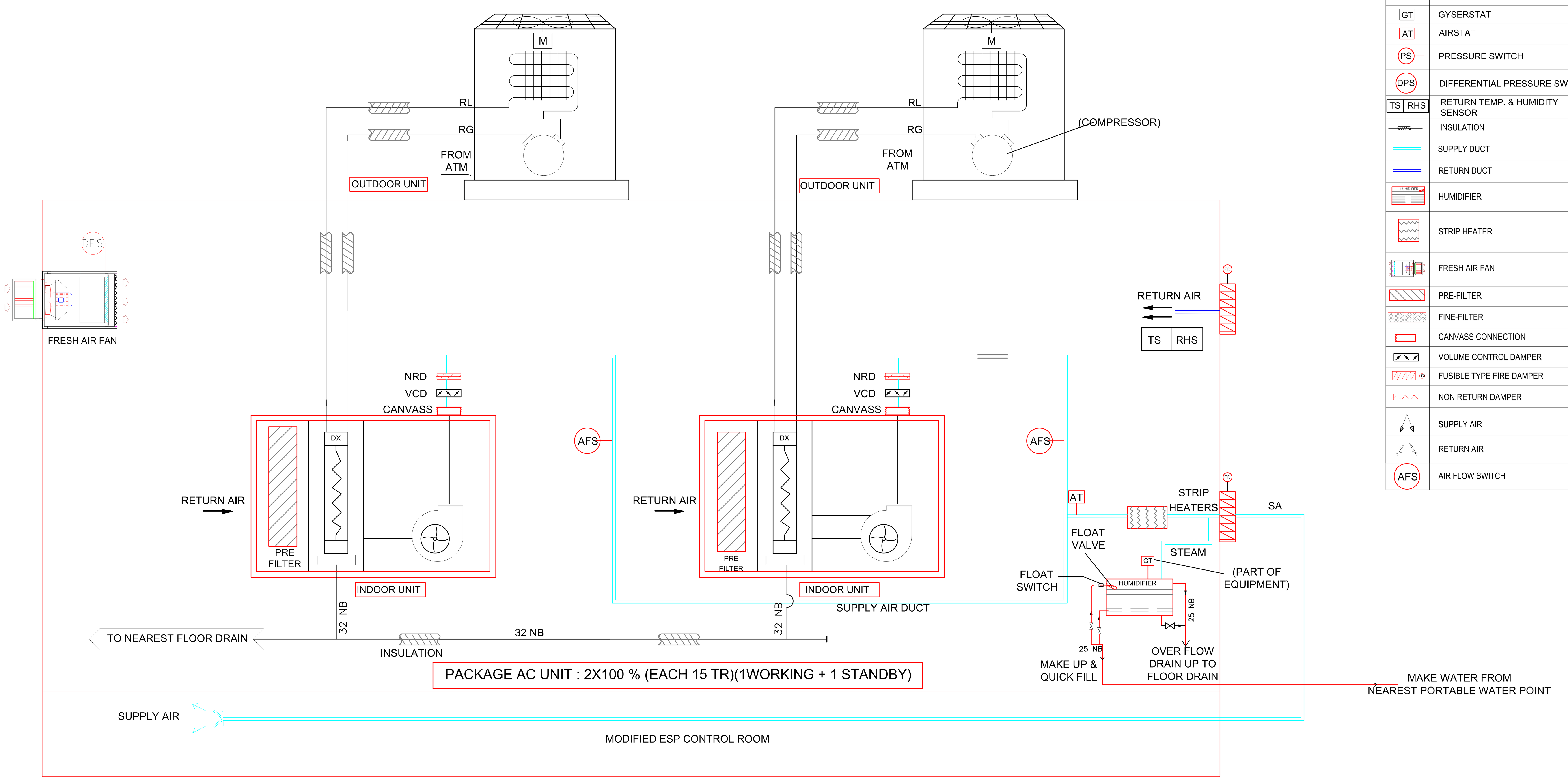
SHEET 1 OF 1

Size A0

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

AIR COOLED PACKAGE AC UNIT : 2x100% (EACH 15 TR)(1WORKING + 1 STANDBY)



SCHEME FOR AIR COOLED PACKAGE AC UNIT FOR MODIFIED ESP CONTROL ROOM BUILDING UNIT-1 (TYPICAL)

L E G E N D

	REFRIGERANT TUBE	AS SHOWN
	GATE VALVE	
	THERMOSTATIC EXPANSION VALVE	AT REFRIGERANT LIQUID TUBE
GT	GYSERSTAT	AS SHOWN
AT	AIRSTAT	AS SHOWN
PS	PRESSURE SWITCH	AT SUPPLY AIR DUCT
DPS	DIFFERENTIAL PRESSURE SWITCH	AT FINE FILTER
TS RHS	RETURN TEMP. & HUMIDITY SENSOR	AS SHOWN
	INSULATION	AS SHOWN
	SUPPLY DUCT	AS SHOWN
	RETURN DUCT	AS SHOWN
	HUMIDIFIER	AS SHOWN
	STRIP HEATER	AS SHOWN
	FRESH AIR FAN	AS SHOWN
	PRE-FILTER	AT AHU INLET
	FINE-FILTER	AT SUPPLY AIR DUCT
	CANVASS CONNECTION	AS SHOWN
	VOLUME CONTROL DAMPER	AS SHOWN
	FUSIBLE TYPE FIRE DAMPER	AT WALL
	NON RETURN DAMPER	AS SHOWN
	SUPPLY AIR	AS SHOWN
	RETURN AIR	AS SHOWN
AFS	AIR FLOW SWITCH	AS SHOWN

NOTES:

1. FOR LEGENDS & SYMBOLS, REFER BELOW GIVEN LEGEND LIST.
2. SUPPLY AIR DUCTS SHALL BE INSULATED AS PER SPECIFICATION.
3. INSULATION SHALL BE FINISHED AS PER SPECIFICATION.
4. DRAINS TO BE ROUTED UPTO THE NEAREST DRAIN POINT.
5. VALVE AND INSTRUMENTS MENTIONED IN SCHEME ARE INDICATIVE MINIMUM. ANY INSTRUMENTS & VALVES REQUIRED FOR SYSTEM COMPLETION, THE SAME SHALL BE PROVIDED WITHOUT ANY IMPLICATION.

FOR TENDER PURPOSE ONLY

SCHEDULE OF VALVES

DESCRIPTION	QTY
GATE VALVE 25 NB	03 NOS.

SCHEDULE OF INSTRUMENTS

DESCRIPTION	QTY.
DIFFERENTIAL PRESSURE SWITCH FOR AIR	01 NOS.
AIR FLOW SWITCH	02 NOS.
AIRSTAT	01 NO.
GYSERSTAT	01 NO.
TEMPERATURE + R. H. SENSOR	01 NO.

PROJECT: 4x210MW KAHALGAON MODIFIED ESP – R&M, UNIT–1 TO 4

CUSTOMER: NTPC LIMITED

CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECTS ENGINEERING MANAGEMENT, NOIDA

DESIGN BY	DARPAN	20.03.2020
CHECKED BY	VK/LJ	20.03.2020
APPROVED BY	GB	20.03.2020
SUPERSEDES		
SUPERSEDED BY		
SYSTEM		

TITLE : SCHEME FOR AIR CONDITIONING SYSTEM

SIZE: PROJECT NO.: 455 FILE NO:

ANNEX: DRAWING NO.: PE-DG-455-571-15000A-A001 REV.00

THIS CAD DRAWING MAY ONLY BE ALTERED WITH A CAD SYSTEM

SIZE-A0

COMPUTER FILE NAME: PE-DG-421-100-M001

DRAWING NO.