shutdown operations without the necessity to start an auxiliary lube oil pump. Self-lubricated bearings shall be equipped with an easily accessible oil reservoir with overflow pipe and oil collecting vessel.

All bearings shall be easily controllable during operation or standstill without dismantling the bearings. The bearings shall further be protected and sealed against dust penetration and oil leakage.

In case of independent bearings, motor and bearing pedestals shall be fitted on a common base plate.

For the transport of motors equipped with ball or roller bearings, special bearing inserts shall be provided to prevent transport damage.

6.4.7 Shafts and Couplings

The motors shall be provided with a free shaft extension of cylindrical shape with key and keyway according to IEC Recommendation 72-1 and with the motor side coupling, which shall be pressed on the motor shaft and be balanced together with it. A coupling guard shall be provided.

6.4.8 Brush gear and Commutators

Brush gear for D.C. motors shall be designed to ensure constant brush pressure. Carbon brushes shall be provided which stand at least 6 months of operation without replacement. Each brush shall be independently adjustable but should not require adjustment throughout its life. A design of brush gear which permits the brush holder to touch the commutator as the brushes wear or which passes current through the pressure fingers will not be accepted.

A sufficient number of brushes, not less than two per pole, shall be fitted to ensure that vibrations do not affect the commutation.

The minimum safe wearing margin of commutators shall not be less than 20 (twenty) per cent of the total thickness of the commutator bars and the minimum safe diameter shall be clearly marked on it.

6.4.9 Terminal Boxes and Earthing

The terminal leads, terminals, terminal boxes and associated equipment shall be suitable for terminating the respective type of cables as specified in these General Technical Specifications and in the Particular Technical Specifications.

The terminal boxes shall be of ample size to enable connections to be made in a satisfactory manner. Supports shall be provided at terminal boxes as required for proper guidance and fixing of the incoming cable.

The terminal boxes with the cables installed shall be suitable for connection to supply systems with the short-circuit current and the fault clearance time determined by the motor protective devices.

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A permanently attached connection diagram shall be mounted inside the terminal box cover. If motors are provided for only one direction of rotation, this shall be clearly indicated.

Terminal boxes shall be totally enclosed and designed to prevent the ingress of moisture and dust. All joints shall be flanged with gaskets of neoprene or similar material. For motors above 1 kW, the terminal box shall be sealed from the internal air circuit of the motor.

Depending on the size, the terminal box of L.V. motors shall be fitted either with an approved cable sealing-end or with a gland plate drilled as required and provided with suitable fittings for cable fixing and sealing. Such openings shall be temporarily plugged or sealed during transportation.

For earthing purposes, each motor shall have adequately sized bolts with washers at the lower part of the frame. In addition, each terminal box shall contain one earthing screw. Each equipment/panel shall be earthed by at least two separate earthing strips.

The cable termination philosophy to be adopted shall be such that extensive grouping of signals by a large scale use of field-mounted group. Junction boxes at strategic locations (where large concentration of signals are available, e.g. switchgear) is done. Termination / Junction boxes shall have either maxi- terminal or cage clamp type terminals

6.4.10 Noise-Level and Vibrations

Under all operating conditions, the noise level of motors shall not exceed 85 dB (A).

In order to prevent undue and harmful vibrations, all motors shall be statically and dynamically balanced.

Vibration displacements or velocity shall be measured in accordance with DIN 45 665 for IEC motor sizes 80 to 315. The results for all motors shall be within the "R" (reduced) limits.

6.4.11 Tests

Each motor shall be factory tested and shall undergo a test at site. The following tests shall be performed under full responsibility of the Contractor.

- Workshop Tests:
- Measurement of winding resistances
- No-load and short-circuit measurements
- Measurement of starting current and torque
- Efficiency measurement (type test)
- Heat test run
- Dielectric test
- Measurement of insulating resistance

- Over speed test
- Site Tests:
- Measurement of insulation resistance
- Measurement of motor vibrations
- Measurement of starting time.

6.5 M.V. AND L.V. SWITCHGEAR, CUBICLES AND PANELS

6.5.1 Starters and contactors

Motor starters and contactors shall be equipped with short circuit protection and local disconnecting devices. Preferably, all starters shall be from one manufacturer. The control circuit voltage shall be obtained from a 415/240 V isolating transformer with primary circuit breaker and secondary fuse. The secondary winding of this transformer shall be grounded. The operating coils of the contactor shall be connected between the grounded side of the transformer and the control contacts.

Starters and contactors shall comply with IEC 292.1 or NEMA IC 1 and be suitable for direct on-line starting, uninterrupted electrical duty, and capable of 30 operations per hour. They shall be installed in ventilated enclosures for indoor installation and weatherproof enclosures for outdoor installation, unless otherwise approved by the Engineer. The enclosures shall be complete with locks, cable sealing boxes, conduit entries, cable gland plates, bus bars, internal wiring, terminal boards, etc. as required by the duty of the starter or contactor.

Starters and contactors shall be of minimum size compatible with motor size and capable of satisfactory operation, without damage, for a period of 5 minutes at a voltage 25 percent below nominal, at nominal frequency.

Thermal type overload and phase failure relays shall be supplied with starters for motors of 7.5 kW or greater. For motors of less than 7.5 kW, suitable rated 3-phase thermal overloads will be acceptable. Ammeters to read current in one phase shall be provided for motors above 7.5 kW.

Each starter shall have sufficient number of auxiliary contacts required for interlocking and indication purposes plus two spare convertible contacts for Owner's use.

6.5.2 Moulded case circuit breakers

All moulded case circuit breakers shall be of 2 or 3-pole type as required, having thermal time delay and instantaneous trips with "On-Trip-Off", indicating/operating mechanism. Circuit breakers used in combination type motor starters or contactors shall have the operating mechanisms interlocked with the starter or contactor cover so that the cover cannot be opened unless the circuit breaker is open. The

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breakers shall comply with applicable section of IEC 157/1 or equivalent standards.

6.5.3 Control relays

Relays used as auxiliary control devices in conjunction with motor starters and magnetic contactors shall be of the type designed for machine tool application featuring contact convertibility. All contacts shall have a minimum thermal current rating of 10A over a range of 6 to 600 V AC.

6.5.4 Pilot devices

Pilot devices such as selector switches, push-button starters and thermostats shall be of heavy duty type and, where mounted outdoors, shall be housed in weather proof enclosures specially designed for the environment.

All electrical contacts for control, alarm and shutdown shall have a thermal current rating of not less than 10 A at 220 V DC.

6.5.5 Terminal blocks

All terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 100 mm and space between the bottom blocks and the cable gland plate being a minimum of 200 mm. Sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables, including spare conductors and drain wires. In addition, 20 percent spare terminals shall be provided. In enclosed cubicles, the terminal blocks shall be inclined toward the door for facilitating terminations.

Terminals shall be of the channel mounting type and shall comprise a system of individual terminals so that terminal blocks can be formed for easy and convenient cabling consistent with the high reliability required of the circuits.

Terminal blocks shall be provided with shorting links and paralleling links where applicable and mounting identification numbers and/or letters.

Terminal blocks shall conform to the applicable standards. The smallest size to be used shall be designated for 2.5-sq. mm wire and not more than two conductors shall be connected under one terminal clamp.

Terminal identification shall be provided corresponding to wire number of connected leads.

Circuit terminals for 415 V AC shall be segregated from other terminals and shall be equipped with noninflammable, transparent covers to prevent contact with live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position.

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6.5.6 Equipment wiring

All wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point.

Splices or tee connections between terminal points are not acceptable. Wire runs shall be neatly dressed inside the panels or in wiring troughs. Whenever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of future equipments.

Multi conductor cables shall be connected to the terminal blocks in such a manner as to minimise crossovers. Approved claw washers of crimp type connector shall be used to terminate all small wiring. Each conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilising slip-on ferrules approved by the Engineer.

Markers may be typed individually or made up from sets of numbers and letters firmly held in place. Open markers will not be accepted.

Markers must withstand a tropical environment and high humidity and only fungus proof materials will be accepted. Ferrules of adhesive type are not acceptable.

All trip circuits shall employ markers having a red background.

Sensitive control circuits shall be effectively shielded against extraneous signals and interference. A separate terminal shall be provided for termination of individual cable shields, which will be grounded at source end only.

6.5.7 Cubicles and control panels

Cubicles and control panel enclosures shall be of sheet steel with minimum thickness of 1.8mm, of rigid, self-supporting construction and supplied with channel bases.

Cubicles shall be fitted with close fitting, gaskets, hinges, lift-off doors capable of being opened through 105 degrees. The doors shall be provided with integral lock and master key.

Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. Under no circumstances shall the floor/roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer.

The cubicles and panels shall be adequately ventilated, if required, by vents or louvers, and shall be so placed as not to detract from the appearance. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable

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extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

Unless stated otherwise, all cubicles and panels shall be provided with a ground bus with 40mm copper bar extending through out the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm^2.

The standard phase arrangement when facing the front of the motor control centres and switchboard shall be RYB from left to right, from top to bottom and front to back. All instruments, devices, buses and other equipments involving 3 phase circuits shall be arranged and connected in accordance with the standard phase arrangement, where possible. Electrical clearances shall conform to applicable standards and shall not require cutting away of adjacent framework.

All instruments, control knobs and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.

The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the manufacturer.

The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of the Engineer. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise.

Switched interior light and socket outlets shall be provided for all cubicles and control panels.

All cubicles and control panels shall be provided with lamacoid nameplates, identifying the purpose of the panel and all of its components.

6.5.8 Alarm contacts

Where applicable, all alarm contacts shall be of galvanically isolated type and provide inputs to the following devices.

- -Local annunciator
- -Station annunciator
- -Supervisory control and sequence of events / fault recorder system.

All alarm contacts shall be changeover type. Where required, relays shall be provided as contact multiplier.

6.6 CABLES

Refer to particular technical specifications Section-IX.

6.7 EARTHING SYSTEM

The contractor of Electro-Mechanical Equipment will make the design calculation and supply the necessary material and install the earthing system during powerhouse construction in co-coordination with civil contractor

6.8 EXPLOSION PROOF WORKS

6.8.1 General

According to the kind of oils and fuels used, explosion in hazardous locations may be caused by standard type electrical works. Therefore, the installation in such locations shall generally be kept to a minimum with said works designed or installed in compliance with the latest issue of IEC recommendation 79 and the appropriate articles of the American National Electric Code (NEC) or the German VDE Standards 0165, 0170 and 0171.

6.8.2 Definition of Hazardous Locations

Hazardous locations shall be defined as follows:

- Class 1, Div. 1 locations are those:
- Where hazardous concentrations of inflammable vapours or gases exist continuously, intermittently, periodically under normal conditions of operation and maintenance and with normal leakage, and
- Where the breakdown or faulty operation of process equipment could release explosive concentrations of fuel and cause simultaneous failure of electrical works.
- Class 1, Div.2 are those:
- Adjacent to Div.1 locations which may occasionally be reached by hazardous concentrations, and
- Where inflammable volatile liquids or gases are handled, processed, or used, but where concentrations are not normally hazardous because liquids or gases are handled in closed systems, and
- Where hazardous concentration is normally prevented by positive ventilation. These locations become hazardous only when the ventilation system fails.

6.8.3 Design features

The design features of electrical works and /or circuits to reach explosion proof condition shall be selected with due regards to the place of installation and the kind of works.

The main features shall be as follows:

- Pressure & flame –proof Enclosure:

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All parts, which may ignite a hazardous atmosphere, shall have an enclosure of sufficient strength to withstand the maximum pressure caused by ignition of the most inflammable mixture of the gas involved. All necessary joints of such enclosures shall be provided with long fits (minimum 25 mm) and close clearances (equal or smaller than 0.6 mm) to cool the escaping flame and to prevent flame propagation to the outside atmosphere.

- Oil Immersion:

The parts capable of igniting inflammable or explosive mixture shall be immersed in oil to such an extent as to prevent ignition of explosive mixtures above the surface of oil by means of sparks or hot gases produced under oil.

- Increased Safety:

To obtain an increased degree of safety on electrical works, special measures shall be taken to prevent non-permissible high temperatures, sparks or arcs inside or outside of the works on which they don't occur under normal working operations.

- Intrinsic safety

All electrical circuits or part of such a circuit shall be considered as intrinsically safe if neither during normal working operation nor under fault conditions explosive mixture is ignited by means of arcs, sparks or any heat generation.

- Any other approved feature not mentioned above but may be felt necessary during the course of execution.

All explosion proof works shall be of approved design and must have undergone type tests according to appropriate standards.

The selection of such works with reference to design features and allocation to hazardous groups shall be subject to approval by the engineer.

6.9 LABELS AND PLATES

6.9.1 General

Labels and data plates shall be provided in accordance with applicable standards and as detailed hereunder.

The proposed material of the labels, size, exact label lettering and proposals for the arrangement of the labels shall be submitted to the Engineer-in-charge for approval.

Where applicable, designations in the selected local language shall appear above or to the right of the designation in the Contract language. The translations into and writings in the local language shall be submitted for approval.

6.9.2 Equipment Labels and Instruction Plates

Labels written in the Contract language shall be provided for all instruments, relays, control switches, push buttons, indication lights, breakers, etc. In case of instruments, instrument switches and control switches, where the function is indicated on the device, no label is required. The label shall be fixed close to the devices in such a way that easy identification is possible. Fixing on the dial glass of instruments will not be accepted. The wording shall conform to the wording used in engineering documents.

Each separate construction unit (cubicle, panel, desk, box, etc.) shall be identified by its Works identification number. Cubicles and similar units shall also bear this identification number on the rear side if rear access is possible. The overall designation of each unit shall be given in the Contract language and - if required - also in a selected local language. These labels shall be made of anodised aluminium with black engraved inscriptions, arranged at the top section of the units. Manufacturer's trade labels shall - if desired - appear in the bottom section of the units.

All Works inside cubicles, panels, boxes, etc., shall be properly labelled with their item number. This number shall be the same as indicated in the pertaining documents (wiring diagrams, Works list, etc.).

Instruction plates in the Contract and selected local language, the sequence diagrams or instructions for maintenance shall be fitted on the inside of the front door of the electrical switchboards.

6.9.3 Warning Labels

Warning labels shall be made of synthetic resin with letters engraved in the Contract and selected local language, where required in particular cases.

For indoor circuit breakers, starters, etc., transparent plastic material with suitably contrasting colours and engraved lettering would be acceptable.

Details are stated in the Particular Technical Specifications or will be fixed at a later date.

6.9.4 Labels for Conduits

The material shall be non-corrosive and the inscription be done with 4 mm high letters/figures.

6.9.5 Labels for Cables

Each cable when completely installed shall have permanently attached to each end and at intermediate positions as may be considered necessary by the Engineer-in-charge, non-corrosive labels detailing identification number of the cable, voltage, and conductor size.

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The cable identification numbers shall comply with those of the cable list.

All cables in cable pits and at the entry to buildings shall be labelled utilising the aforementioned type of label.

6.9.6 Rating Plates

Works (hoists, machines, transformers, etc.) rating plates and other technical data/informative plates shall either be of the enamelled type or be of stainless steel suitably protected after engraving with a transparent paint resistant to aggressive atmosphere and solar radiation.

6.9.7 Single-Line Diagrams

Each switchgear room shall be furnished with a copy of the final as-built single-line diagram detailing all electrical data and denominations, separate for each individual switchgear / distribution board / MCC, placed under glass and frame/wall mounted at an approved location.

The same applies to the Station Single-Line Diagram one copy of which shall be arranged in the control room(s).

6.8 KEY SYSTEM FOR ELECTRIC BOARDS

Key interlocked switches shall be provided with Yale or other approved locks for locking in the neutral position. Similar locks shall be provided for selector switches for locking the switches in any of the positions.

The locks or padlocks shall be co-ordinated for the different applications and shall be supplied with three keys. A key cabinet at the end of each board (distribution board, MCC, control cubicles, etc.) shall be provided for storing the keys of that board. All keys shall have six master keys to open any lock or padlock supplied. Each key shall have one identification label fixed above the key-hanging hook inside the cabinet.

The cabinet door keys shall be similar and shall be six (6) in number.

PLC SPECIFICATION

	TITLE:	SPECIFICATION NO. PES-145-36	
BHEL	**SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM**	VOLUME **II-B**	
		SECTION **D**	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 1	OF 11

1. SCOPE

This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to site, erection & commissioning, site acceptance test of the PLC Control & Monitoring System comprising PLC Control panel/Remote I/O panel (housing Processors, I/O cards, power supply packs etc.), Operator workstations(OWS), Printers, Annunciation system, UPS, cables and all other equipment and accessories required for completeness of the system as mentioned in different sections of this specification.

2. GENERAL

2.1. The offered PLC shall be of Industrial Grade and from Original Equipment manufacturer (OEM).

2.2. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, math functions, input quality checking engineering unit conversion, Boolean functions & PID control (Analog logic function) etc.

2.3. The system shall be redundant in processor, power supply and communication interfaces unless otherwise specified. The control of all drives and equipment shall be effected through the keyboard/mouse / panel mounted push button / control switches as per Data sheets-A&B. The system shall include self-diagnostic features not limited to the following:-

- Memory Faults, both PROM and EPROM
- Processor Faults
- Communication Faults
- I/O interface or address faults
- Voltage signal discrepancy on input and output
- Power supply faults
- Output loop check
- Channel level diagnostics such as fault monitoring, contact bounce filtering etc.
- Failure of main or I/O processor

2.4. The system shall have facility for connecting to Main Plant's Distributed control system (DCS) using hardware/software interface for two-way transfer of signals.

2.5. The mimic shall be displayed on the OWS screen and may also be provided on the control desk/panel (as per Datasheet).

2.6. In case OWS is provided, HMI functions like trends, curves, bar charts, historical storage of data, logs and reports etc. shall be provided in addition to Plant schematics. The necessary catalogue / literature elaborating the features of HMI shall be supplied along with the bid.

2.7. It shall be possible to use the same OWS as programming station.

2.8. The PLC system shall be sized to meet process/system requirements as per the approved P&IDs and Control write-up.

2.9. The PLC system shall be designed to ensure that no single device failure should result in failure of any other device.

2.10. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.

2.11. Bidder shall provide all software on CDs along with required software licenses .The original CDs of installed operating & application software shall be maintained by bidder. Software modification and up gradation (as & when required) shall also be covered under the vendor scope without any cost implication.

2.12. PLC programming console shall be provided with industry proven antivirus software with perpetual license (free version not acceptable).

3. TECHNICAL REQUIREMENTS

Details of various PLC system components shall be inclusive of but not limited to the following:

3.1. CODES AND STANDARDS

3.1.1. The equipment covered under this specification shall meet the requirements of latest edition of all applicable codes and standards like ANSI, NEMA, IEEE, IEC, NEC & IS.

3.1.2. PLC shall conform to IEC: 61131

3.1.3. The offered PLC shall comply with safety standards as per Data sheet-A&B.

3.2. CONTROL PANEL

3.2.1. PLC control panel shall be freestanding type with provision for mimic display, push-button stations, control switches, indicating lamps, metering instruments like Indicators, ammeters etc. and facia windows for critical alarms.

3.2.2. 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) and not less than 1.6 mm for others
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.2.3. Each panel shall be identified by a name plate, which shall be of non-rusting metal or three ply lamicold, with engraved lettering.

3.2.4. Vendor shall indicate earthing details along with bid.

3.2.5. 25 x 6 mm Copper ground bus to be provided for each panel.

3.2.6. 240V AC single phase, thermostatically controlled space heaters shall be provided. Each free standing panel shall have a door switch operated fluorescent lamp and a 240V AC plug point.

3.2.7. Painting treatment shall be as per IS: 6005. Two coats of lead oxide primer shall be followed by powder coating. Paint shade shall be as specified in the “Data sheet for PLC system”-Data Sheet-A&B. Project specific paint shade, if applicable, shall be followed.

3.2.8. Panel internal wiring shall be as per NEC and NEMA standard.

3.2.9. TB points in terminal block shall be cage clamp type/screw type.

3.2.10. The annunciation system shall be facia window type, driven by the PLC. Audible alarm, Acknowledge, Reset and lamp test facility shall be provided as per ISA sequence – S18.1, M.

3.3. PROCESSORS

3.3.1. The microprocessors shall be 32 bit, and Hot redundant.

3.3.2. Hot redundancy: PLC shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete operation automatically. This transfer from main processor to standby processor shall be bump less and shall not cause any disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processor as master and other as standby.

3.3.3. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements.

3.3.4. The standby processor shall be updated automatically in line with the changes made in the working processor.

3.3.5. In the event of any replacement of the processor, synchronization of the replaced processor shall be automatic upon live insertion.

3.3.6. The cycle time for input scanning, execution of logics, overheads and output scan shall not exceed 120 m sec.

3.3.7. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions.

3.3.8. The memories shall be field expandable. Memory capacity shall be sufficient for complete system operation and have a capability for at least 20% expansion in future.

3.3.9. Memory shall be non-volatile, preferably EEPROM type. However, in case volatile memory is provided, battery backup shall be provided for a minimum of three months to keep the stored program intact. Battery drain indication shall be provided at least 1 week before the battery gets drained and same shall be annunciated in OWS.

3.4. INPUT / OUTPUT Modules

3.4.1. Input/output card assignments shall be modular i.e. no single card shall be assigned with more than one drive of a particular sub-system. The maximum number of channels per I/O module shall be as follows.

- Analog Input Module: 8
- Analog Output Module: 8
- Binary Input Module: 16
- Binary Output Module: 16
- Analog Input/output combined: 16
- Binary Input/output combined: 32

3.4.2. On line module replacement (hot swappable): All modules cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching off the power supply.

3.4.3. Each I/O shall be protected against the reversal of polarity of the power voltage to I/O.

3.4.4. 10% spare capacity shall be ensured in each card channel assignment. Overall minimum 20% spare channels shall be provided.

3.4.5. Output command to MCC/Switchgear shall be through coupling relays, whose mounting location shall be as per “Data sheet A & B for PLC System”. In case coupling relays are located in PLC Panel, the same shall be in PLC vendor’s scope of supply.

3.4.6. Status feedback from MCC shall be in the form of potential free contact.

3.5. DATA BUS/ I/O BUS

3.5.1. The Data bus connecting PLC and HMI work stations shall be TCP/IP on Ethernet.

3.5.2. The Data bus and I/O bus communication medium shall be twisted pair shield copper conductor for indoor locations and those areas not subjected to induced signals. Repeaters/signal amplifiers shall not be used. Copper conductor cable used shall be Category-5 or better. The communication medium shall be Fibre optic cable in the event any portion of communication cable run is in outdoor or where distances are beyond 500 meters.

3.6. OPERATOR WORK STATION (OWS)

3.6.1. The OWS and Keyboard shall be desktop mounted and shall be used for controlling, monitoring and programming function.

3.6.2. Colour CRT(s) with keyboard and mouse shall be as per Data Sheet-A&B. CRT shall have graphic display facility.

3.6.3. The OWS shall be with Windows based operating system having necessary Engineering/Configuring software.

3.6.4 Specification of OWS

(a) CPU

1. Processor	32 Bit or better
2. Main Memory	Min. 1 GB and expandable to at least 4 GB
3. Hard drive	Min 40 GB
4. Floppy drive	3.5”, 1.44 MB
5. Removable bulk storage	DVD (R/RW)
6. Graphic memory	Min. 16 MB
7. Auto controller	16 bit or better
8. Operating system	Window XP or better
9. Communication ports	2 serial, 1 parallel, 8 Nos. USB, Dual 100 MB Ethernet
10. Expansion slot	3 Nos. or more

(b) Monitor

1. Type	LCD colour monitor (TFT based)
2. Screen diagonal	22” (approx.) flat
3. Display	XGA or better
4. Degree of Protection	IP-30
5. External controls	Brightness, Contrast, Horizontal/vertical amplification & shift
6. Power supply	240 VAC, 50 Hz, 1 phase
7. Version	Industrial grade

(c) Keyboard & Mouse

1. Type	Flat spill membrane or positive depression type ASCII
2. Life expectancy	50 Million cycles per key
3. Version	Industrial
4. Mouse	Optical

3.7. PRINTER

Printers shall be provided as per Data Sheet-A&B.

3.8. COMMUNICATION WITH PLANT DCS/ THIRD PARTY SYSTEM

3.8.1. The PLC system shall be provided with hardwired/serial interface for communication with plant DCS. Hardwired outputs from PLC shall be isolated. Necessary isolators shall be part of PLC.

3.8.2. Serial communication to / from DCS where provided shall be engineered to ensure that signal communication time from / to DCS shall not exceed 1 seconds for control / feedback.

3.8.3. Serial communication to DCS shall be OPC (Data access 2.0), Ethernet based TCP/IP Protocol. Alternatively the serial communication shall be MODBUS protocol on RS 485 network.

3.8.4. Data transmitted from PLC to DCS shall include all information necessary for the DCS graphic displays to monitor and control the process equipment and PLC. Such data may include pertinent analog and digital status information, interlock, alarms and maintenance conditions. Data transmitted from DCS to the PLC shall include necessary signals to provide operator control interface from DCS for the process/ equipment being controlled by PLC.

3.8.5. Bidder to include 'Light interface units, converters, Ethernet switch, accessories etc. at both ends viz PLC and DCS for connectivity to other system. The bidder's terminal point shall be Ethernet port in case of copper medium connection to DCS or LIU in case of Fiber optic medium for connectivity with plant DCS. In case distance between PLC & DCS is greater than 1.8 Km, single mode of optical fiber cable with compatible accessories shall be used. For distance less than 1.8 Km multimode optical fiber ports shall be used.

3.9. POWER SUPPLY Scheme

3.9.1. PLC Panel and I/O Cabinets: PLC system shall be provided with 2x100% UPS fed from Two Nos. redundant 415V, 3-ph feeders, as per the scheme PE-SD-999-145-001, sh-08 of 08. Each UPS shall have 30 minutes back up. Input feeder failure shall be monitored in the PLC system. Necessary redundant power pack and transformers shall be provided (in the PLC panel) to derive the power supply for control desk, PLC panel and input / output cabinets etc

3.9.2. Remote I/O panels: Similar power supply arrangement as for PLC panels shall be provided if it is not possible to extend the power cable form UPS of PLC panels.

3.9.3. Each OWS and associated HMI peripherals shall be provided with a feeder from Either one of the UPS

4. DRAWING/DOCUMENT AND DATA TO BE FURNISHED AFTER AWARD OF THE CONTRACT:

4.1. For Approval:

- PLC system configuration drawing along with functional write-up.
- Input/output signal list.
- BOM of PLC
- List of PLC controlled devices
- Control panel/control desk GA drawings.
- Control desk/panel component layout drawing.
- Control panel/control desk Foundation detail and cutout drawings.

- Power distribution scheme.
- Block logic diagrams/ Ladder diagram mimic.
- Annunciation list.
- PLC control room layout drawing.
- List of soft signal exchange with Plant DCS.
- List of mandatory spares.
- UPS load calculation details.
- Quality plan
- FAT
- Data Sheet-C
- CRT display
- Power supply scheme for PLC system, HMI & peripherals, Remote I/O etc.

4.2. For Information:

- Cable schedule and cable interconnection drawing(in BHEL approved format)
  - Between Field and PLC
  - Between Field and MCC
  - Between MCC and PLC
- Electronic earthing requirements.
- Panel Heat dissipation data
- Product/component catalogues.
- Operation & Maintenance Manual on CDs.
- Softcopy of Final/As-built drawings on CDs.
- Calculation for Processor, Memory & Data bus loading

The above list is the minimum requirements. Additional documents/calculations required shall be finalized during contract stage.

5. DRAWINGS AND DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID

- Proposed PLC system configuration drawing with write-up
- Product catalogues and specifications for PLC as well as HMI application.
- Proposed power supply schemes for PLC system, peripherals, and Remote I/O panels.

6. TESTING AND INSPECTION

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

6.2. BHEL's standard Quality Plan for PLC 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.

6.3. The complete PLC system, including all instrument and devices shall be subjected to standard factory tests (i.e. Type Tests and Routine Tests) as per relevant IS, NEMA, IEEE, IEC.

6.4. Factory Acceptance Test-FAT (Functional Tests) shall be performed prior to shipment and Owner/Purchaser shall be notified 15 days before the schedules dates of the test.

6.5. The certificates for following type tests, as per IEC Standard, shall be submitted: -

- Surge protection test as per IEC-225-4
- Dry heat test as per IEC-68-2-2
- Damp Heat test as per IEC-68-2-3
- Vibration Heat test as per IEC-68-2-6
- Electrostatic discharge test as per IEC-801-2 or equivalent
- Radio frequency Immunity test as per IEC-801-6 or equivalent
- Electromagnetic Immunity test as per IEC-801-3 or equivalent

7. SPARES AND CONSUMABLES

7.1. 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.

7.2. Mandatory Spares

The bidder shall offer along with 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.

7.3. 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 along with unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

7.4. Special Tools & Tackles

The bidder shall supply all Special Tools & Tackles 'as required' during Start-up and further maintenance of the system, as part of the main equipment supply.

7.5. Spares, Service support

Bidder shall provide availability of spares and service support for minimum 15 years after guarantee period.

8. MARKING AND PACKING

8.1. Marking:

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag/serial Number and salient technical specification.

8.2. Packing:

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, 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.

9. PERFORMANCE AND GUARANTEE

The PLC system shall be guaranteed to meet the performance requirement as specified and also for trouble-free continuous operation for 12 months from the date of commissioning or 18 months from the date of delivery at site whichever is later unless specified otherwise in Vol-IIB Section - B or Section - C.

10. APPLICABLE DATA SHEET FORMS

This document shall be read with the following data sheet forms :

- Data Sheet A & B for PLC system - PE-DC-999-145-I036-1
- Data Sheet C for PLC system - PE-DC-999-145-I036-2

PLC DATA SHEET

	DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM	SPECIFICATION NO.: PE-TS-411-	
		VOLUME II B	
		SECTION D	
		REV. NO. 00	DATE: 19.03.2015
		SHEET 1 OF 2	

Data Sheet No.: PES-145-36-DS1-0

Data Sheet A&B

		DATA SHEET – A FOR PLC SYSTEM **(TO BE FILLED BY PURCHASER)**	DATA SHEET – B FOR PLC SYSTEM **(TO BE FILLED BY BIDDER)**
GENERAL	PROJECT	4X270 MW BHADRADRI TPS	
	SERVICE	AIR CONDITIONING & VENTILATION SYSTEM	
	QUANTITY	☐ UNITISED ■ COMMON	
	LOCATION	■ INDOOR ☐ OUTDOOR ■ AC ☐ NON-AC*	
PLC EQUIPMENT	MAKE / MODEL NO.	BIDDER TO INDICATE	
	PROCESSOR	REDUNDANT WITH HOT STANDBY	
	DATA BUS (HMI)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (REMOTE I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	FIELD CONTACTS INTERROGATION VOLTAGE	■ 24 V DC ☐ 48 V DC ☐ 110 V AC	
	LOCATION OF COUPLING RELAYS	■ MCC ☐ PLC PANEL	
	DESKTOP OWS QUANTITY	☐ ONE ☐ TWO ☐ _____ ■ DESKTOP VERSION ☐ SERVER VERSION ☐ WORK STATION VERSION REQUIREMENT OF OWS IN CCR ☐ YES ☐ NO QUANTITY_____	OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification.
	DESKTOP MONITOR TYPE	☐ 19" ■ 24" TFT/CRT MONITOR ☐ GIU ☐ OTHERS	
	PRINTER	INKJET ☐ A3___NOS ☐ A4___NOS LASER B/W ☐ A3___NOS ☐ A4___NOS COLOR INKJET ☐ A3 __NOS ☐ A4___NOS COLOR LASER ■ A3_1_NOS ☐ A4___NOS	
	PROGRAMMING / CONFIGURATION FACILITY	A) ☐ HAND HELD ☐ LAPTOP B) ENGINEERING SOFTWARE ☐ ONE OWS ☐ ALL OWS ☐ LAPTOP	OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification.
	SAFETY STANDARD	☐ SIL-3 ☐ SIL-2 ■ NIL	
	COMPUTER FURNITURE	BOQ ■ YES ☐ NO INDUSTRIAL GRADE ■ YES ☐ NO	
SPARE LIST	SPARE LIST	☐ START UP & COMMISSIONING ■ MANDATORY SPARE ☐ RECOMMENDED	
	SPARE LIST ATTACHED	■ YES ☐ NO	
REDUNDANCY	CPU	■ YES ☐ NO	
	POWER SUPPLY	■ YES ☐ NO	
	COMMUNICATION	■ YES ☐ NO	
	I/O CARD	☐ YES ☐ NO	
	OTHER ELECTRONICS	☐ YES ☐ NO	**As per vendor practice**

	DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM	SPECIFICATION NO.: PE-TS-411-	
		VOLUME II B	
		SECTION D	
		REV. NO. 00	DATE: 19.03.2015
		SHEET 2 OF 2	

Data Sheet No.: PES-145-36-DS1-0

Data Sheet A&B

		DATA SHEET – A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)	DATA SHEET – B FOR PLC SYSTEM (TO BE FILLED BY BIDDER)
No. of CHANNELS PER CARD	ANALOG INPUT	■ 8 NOs ☐ 16 NOs	
	ANALOG OUTPUT	■ 8 NOs ☐ 16 NOs	
	BINARY INPUT	■ 16 NOs ☐ 32 NOs	
	BINARY OUTPUT	■ 16 NOs ☐ 32 NOs	
	RTD**	4 NOs	
	THERMOCOUPLE**	8 NOs	
	ELECTRONIC CARD ISOLATION	☐ GALVANIC ☐ OPTICAL ☐ OTHER	
PANEL	QUANTITY	BIDDER TO INDICATE	
	CLASS OF PROTECTION(Refer Location of PLC)	■ IP-42	
	REMOTE I/O PANEL	■ YES ☐ NO AC REQUIREMENT ■ YES ☐ NO	
	COLOUR#	RAL 7032	
	BACK-UP DESK	☐ YES ■ NO	
	MIMIC	☐ YES ■ NO IF YES,THEN ☐ PANEL MOUNTED GUI ☐ ACRYLIC	
	CONTROL HARDWARE	☐ PB ☐ INDICATORS ■ FACIAS 25 Nos. ☐ OTHERS	
	CONFORMAL COATING	☐ YES ■ NO	
COMMUNICATION WITH OTHER SYSTEM	HARDWIRED	■ YES ☐ NO	
	PURPOSE	☐ CONTROL ■ MONITORING	
	MEDIUM	☐ UTP ■ FIBRE OPTIC ☐ OTHERS	
	TIME SYNCRONIZATION SIGNAL FORMAT	☐ PULSE ☐ RS-485 ■ IRIG-B ☐ NTP	
	SOFTLINK	☐ MODBUS ■ OPC IF MODBUS THEN ☐ RS-485 ☐ ETHERNET	
	SERIAL LINK	COMMUNICATION PORT TYPE _____	
POWER SUPPLY INPUT FEEDER	PLC PANEL	BIDDER TO INDICATE LOAD DATA	
	REMOTE I/O PANEL	BIDDER TO INDICATE LOAD DATA	
POWER SUPPLY	SOURCE $$	■ UPS (INDUSTRIAL GRADE) ☐ 24V DC CHARGER	
	BATTERY TYPE	☐ Ni-Cd ■ LEAD ACID ☐ OTHERS	
	BACK-UP TIME	☐ 30 MINS ■ 60 MINS ☐ OTHERS	
	BATTERY CONFIGURATION	☐ 1X100% ■ 2X100% ☐ 2X50%	As per MAX philosophy
CUSTOMER TRAINING	TRAINING	■ REQUIRED ☐ NOT REQUIRED	
	NO OF DAYS	3 DAYS	
	LOCATION	☐ VENDOR'S WORK ☐ PROJECT SITE ☐ OTHERS	

*IF THE LOCATION IS INDOOR,KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.
**SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.
PROJECT SPECIFICPAINT SHADES, IF APPLICABLE TO BE USED.
$$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.

BHEL	**DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM**	SPECIFICATION NO.: VOLUME II B SECTION D REV. NO. 03 DATE: 21.03.2014 SHEET 1 OF 2

Data Sheet No.: **PES-145-36-DS2-0**

DATA SHEET – C

GENERAL	PROJECT	
	SERVICE	
	QUANTITY	
	LOCATION	
PLC EQUIPMENT	MAKE / MODEL NO.	
	PROCESSOR	
	DATA BUS (HMI)	
	DATA BUS (I/O - CPU)	
	DATA BUS (REMOTE I/O - CPU)	
	FIELD CONTACTS INTERROGATION VOLTAGE	
	LOCATION OF COUPLING RELAYS	
	DESKTOP OWS QUANTITY	
	DESKTOP MONITOR TYPE	
	PRINTER	
	PROGRAMMING / CONFIGURATION FACILITY	
	SAFETY STANDARD	
	COMPUTER FURNITURE	
SPARE LIST	SPARE LIST	
	SPARE LIST ATTACHED	
REDUNDANCY	CPU	
	POWER SUPPLY	
	COMMUNICATION	
	I/O CARD	
	OTHER ELECTRONICS	
No. of CHANNELS PER CARD	ANALOG INPUT	
	ANALOG OUTPUT	
	BINARY INPUT	
	BINARY OUTPUT	
	RTD**	
	THERMOCOUPLE**	
	ELECTRONIC CARD ISOLATION	
PANEL	QUANTITY	
	CLASS OF PROTECTION(Refer Location of PLC)	
	REMOTE I/O PANEL	
	COLOUR#	
	BACK-UP DESK	
	MIMIC	

	DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM	SPECIFICATION NO.:
		VOLUME II B
		SECTION D
		REV. NO. 03 DATE: 21.03.2014
		SHEET 2 OF 2

Data Sheet No.: **PES-145-36-DS2-0**

DATA SHEET – C

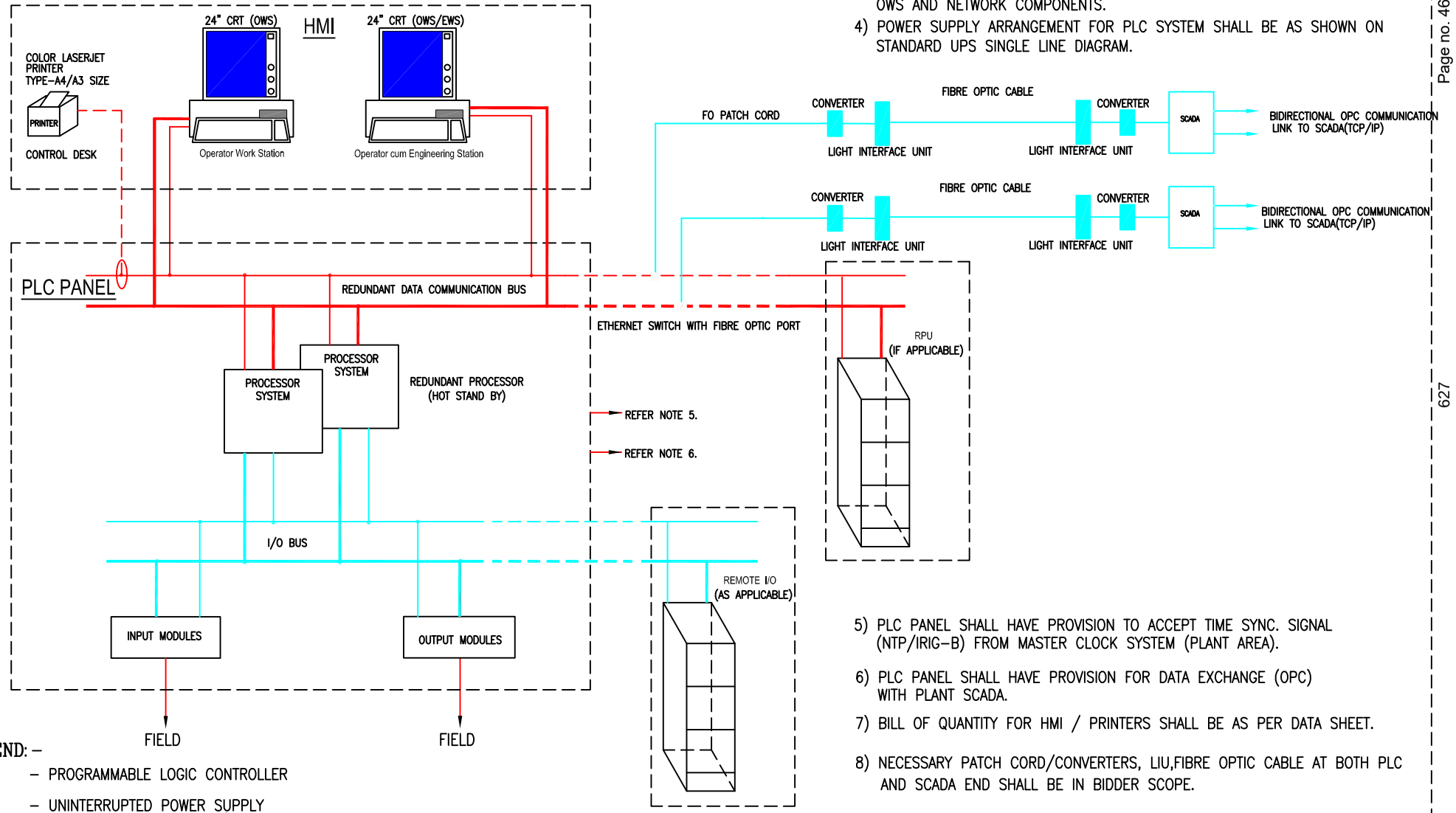
	CONTROL HARDWARE	
	CONFORMAL COATING	
COMMUNICATION WITH OTHER SYSTEM	HARDWIRED	
	PURPOSE	
	MEDIUM	
	TIME SYNCRONIZATION SIGNAL FORMAT	
	SOFTLINK	
	SERIAL LINK	
POWER SUPPLY INPUT FEEDER	PLC PANEL	
	REMOTE I/O PANEL	
POWER SUPPLY	SOURCE $$	
	BATTERY TYPE	
	BACK-UP TIME	
	BATTERY CONFIGURATION	
CUSTOMER TRAINING	TRAINING	
	NO OF DAYS	
	LOCATION	

*IF THE LOCATION IS INDOOR,KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.
**SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.
PROJECT SPECIFICPAINT SHADES, IF APPLICABLE TO BE USED.
$$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.

PLC CONFIGURATION

NOTES:

1) TABLE TOP OWS/EWS SHALL BE 24" OR AVAILABLE INDUSTRY STANDARD.
2) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR,POWER SUPPLY AND COMMUNICATION SYSTEM.
3) UPS POWER SUPPLY SHALL BE PROVIDED BY BIDDER FOR PLC PANEL(S), OWS AND NETWORK COMPONENTS.
4) POWER SUPPLY ARRANGEMENT FOR PLC SYSTEM SHALL BE AS SHOWN ON STANDARD UPS SINGLE LINE DIAGRAM.



5) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (NTP/IRIG-B) FROM MASTER CLOCK SYSTEM (PLANT AREA).
6) PLC PANEL SHALL HAVE PROVISION FOR DATA EXCHANGE (OPC) WITH PLANT SCADA.
7) BILL OF QUANTITY FOR HMI / PRINTERS SHALL BE AS PER DATA SHEET.
8) NECESSARY PATCH CORD/CONVERTERS, LIU,FIBRE OPTIC CABLE AT BOTH PLC AND SCADA END SHALL BE IN BIDDER SCOPE.

LEGEND: –

PLC – PROGRAMMABLE LOGIC CONTROLLER
UPS – UNINTERRUPTED POWER SUPPLY
OWS/EWS – OPERATOR WORK STATION/ ENGINEERING WORK STATION
HMI – HUMAN MACHINE INTERFACE
NTP – NETWORK TIME PROTOCOL
OPC – OLE PROCESS CONTROL
MCCB – MOULDED CASE CIRCUIT BREAKER
MCB – MINIATURE CIRCUIT BREAKER
RPU – REMOTE PROCESSING UNIT

PLC SYSTEM CONFIGURATION 2X60MW VYASI HEP HVAC SYSTEM	DRG. NO.	PES-145-36A	
	REV. No.	00	DATE 29.05.2015
	SHEET	01 OF 01	

Dwg. no. PE-TS-410-145-I881A

PLC Quality Plan

PEM :: C&I

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.:	**PE-QP-999-145-I036___**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 24.08.2007
SHEET	1 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.0	**Materials /Components**											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection • Identification Labels • Physical Damages • Quantity • Spare Capacity	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1	

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LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL 2 - Vendor 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.:	**PE-QP-999-145-I036___**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 24.08.2007
SHEET	2 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1	

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LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.

1 - BHEL; 2 - Vendor; 3 - Sub-vendor

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
2.0	**Assembly**											
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2	1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2	2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2	1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100%	FAT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2	2	1	

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LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
3.0	**Factory Acceptance Test (FAT)**											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL 2 - Vendor 3 - Sub-vendor

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FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

a) Technical Specification of PLC.

b) PLC System Configuration

c) General Assembly Drawings.

d) Panel Wiring Diagrams.

e) Bill of Quantity for PLC System.

f) Logic Diagram.

g) HMI Schematics.

h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, to the inspecting agency, his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. Check online replacement of cards, processors, power supply etc.

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

i) Redundancy

ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.
Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

6. Control Panel /Desk Verification

i) PLC driven annunciation system should be checked by alarm signal simulation.

ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.

iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes

ii). Engineering features:-
a) Online changing of parameters, set points.
b) Online modification in Control Logic Diagrams.
c) Online configuration of Graphics, Trends, Logs, HSR.

iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.

Actuator Data Sheet

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-999-145-I007 VOLUME II B SECTION D REV. NO. 03 DATE: 20.06.13 SHEET 1 OF 3

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT	
	OFFER REFERENCE	
	* TAG NO. SERVICE	
	* DUTY	☐ ON / OFF ☐ INCHING
	* LINE SIZE (inlet/outlet): MATERIAL	
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY
	* OPENING / CLOSING TIME	
	* WORKING PRESSURE	
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:65
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.**
HANDWHEEL	* REQUIRED	■ YES ☐ NO
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.	
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF **I.S.** TOLERANCE
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐ .....
	PAINT TYPE **(## Refer Notes)**	☐ ENAMEL ☐ EPOXY ☐ .....
	SHAFT RPM	BIDDER TO SPECIFY
	OLR SET VALUE	BIDDER TO SPECIFY
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-999-145-I007 VOLUME II B SECTION D REV. NO. 03 DATE: 20.06.13 SHEET 2 OF 3

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ☐ FLAME PROOF	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ☐ ----------	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	☐ REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	☐ CONTACTORS ☐ THYRISTORS	
	TYPE	☐ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	IF SMART		
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐.....	
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC	
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....	
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP	
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	☐ REQUIRED	
	OPEN / CLOSE PB	☐ REQUIRED ☐ NOT REQUIRED	
	STOP PB	☐ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	☐ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	☐REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	☐ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER	
	QUANTITY	☐ 2 NOs. ☐ 3 NOs.	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms	
TORQUE SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
LIMIT SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	■1 No ☐2 Nos. / 2 Nos. (ADJ.) / ■1 No. ☐2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-SS-999-145-I007	
		VOLUME II B	
		SECTION D	
		REV. NO. 03	DATE: 20.06.13
		SHEET 3 OF 3	

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☐ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	■ 24V DC ☐	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@☐ IP 68 @☐.....	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☐ NOT REQUIRED☐ ☐ 2 NOS. ☐ ----------	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:----------	
	@ SPACE HEATER CABLE GLAND	SIZE:----------	
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :----------	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
   IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

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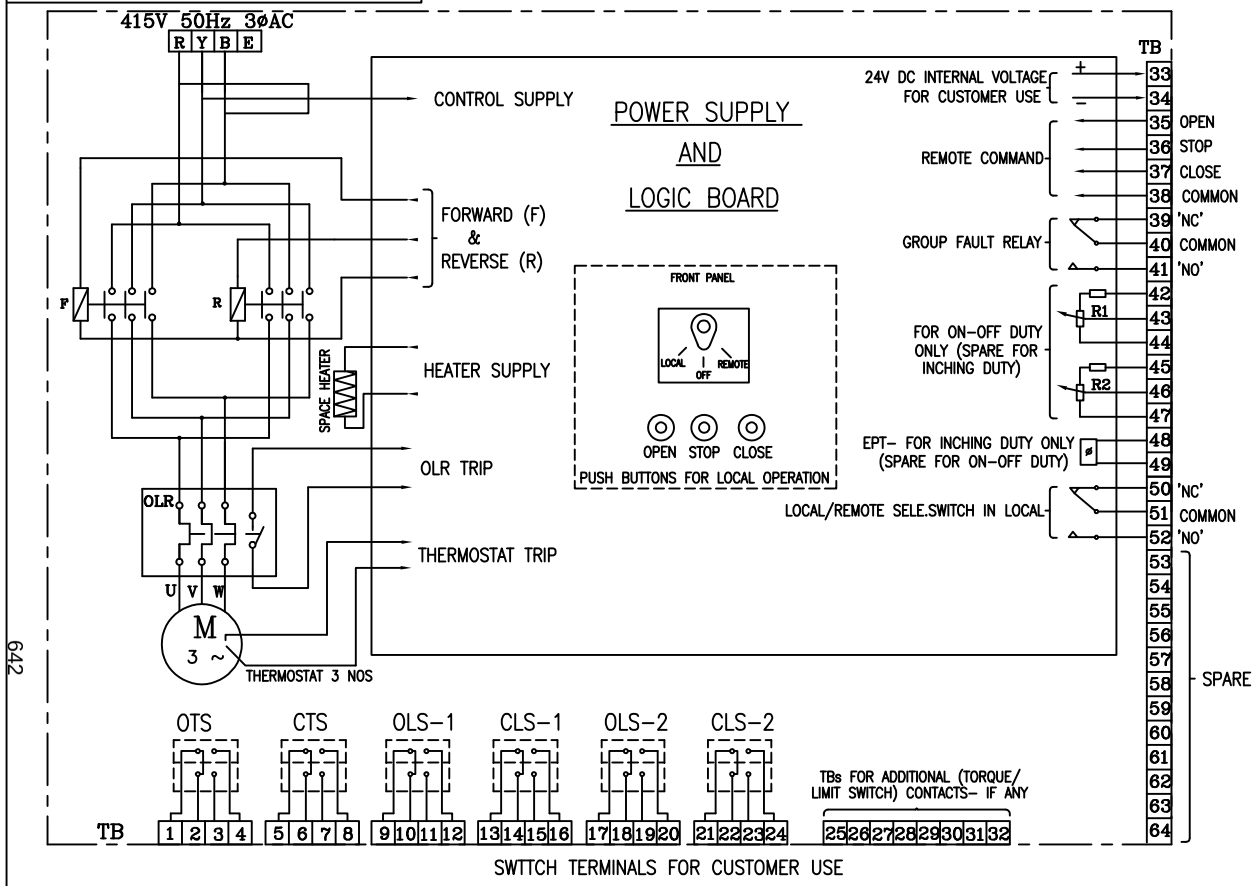
	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME	ANUJ WADHWA	CHETAN MALIK	M.A.MANSOORI	NAME
SIGNATURE				SIGNATURE
DATE	20.06.2013	20.06.2013	20.06.2013	DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES

Data Sheet A & B

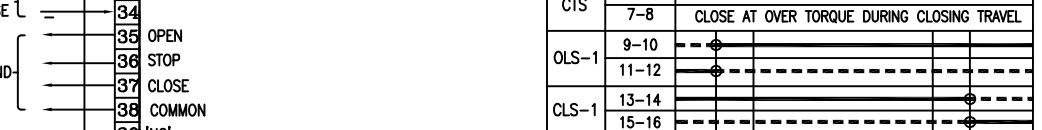
DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

DRAWING NO. 3-V-MISC-24227



CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	



INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#

\# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

NOTE:-

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
2. CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
6. EPT - ELECTRONIC POSITION TRAMSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M - MOTOR 3ø 415V 50 Hz AC SUPPLY

REV	DATE	ALTERED
		CHD & APPD

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.
365-121

	NAME	SIGN	DATE	NO.OF VAR.
DRN	N.P.ESWAR	N.P	07.10.04	
CHD	D.DINAKARAN	D.D	07.10.04	
APPD	K.ARUNACHALAM	K.A	07.10.04	

DEPT: VL | CODE | SCALE | WEIGHT (KG). | REFERENCE INFORMATIONS | NO. OF ITEMS

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER

CARD CODE: U 01

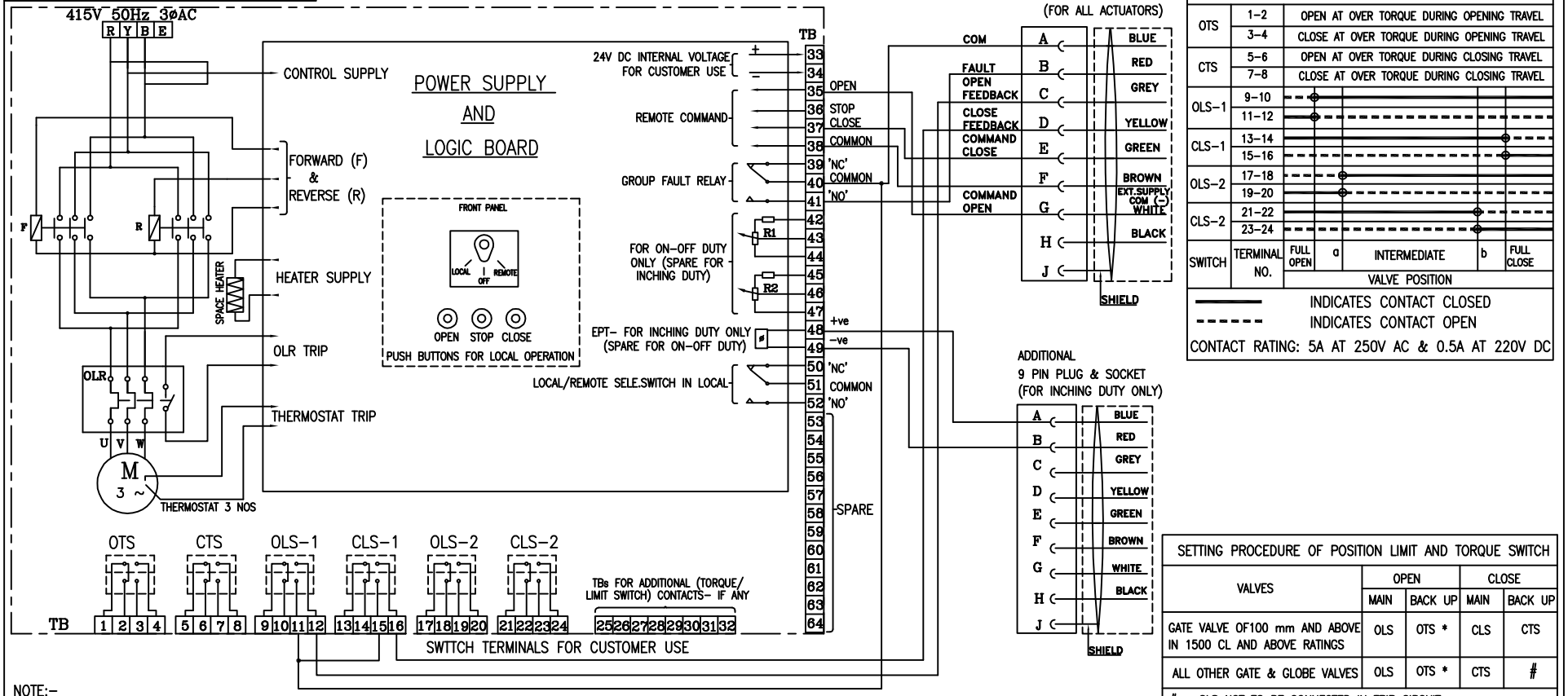
DRAWING NO.: 3-V-MISC-24227

REV: 0

Size A3

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.

DRAWING NO. 3-V-MISC-24550



CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	

SWITCH	TERMINAL NO.	FULL OPEN	a	INTERMEDIATE	b	FULL CLOSE
		VALVE POSITION				

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#

- CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

* - BYPASS OTS FOR INITIAL 5% OF TRAVEL(FOR GATE VALVES ONLY)

NOTE:-

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
2. CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
6. EPT - ELECTRONIC POSITION TRAMSMITTER (FOR INCHING DUTY)
7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M - MOTOR 3ø 415V 50 Hz AC SUPPLY
10. TORQUE SWITCH BYPASS WITH LIMITSWITCH BOTH ON OPEN & CLOSE DIRECTION TO BE DONE INTERNALLY.

REV	DATE	ALTERED
		CHD & APPD

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS AND PLUG & SOCKET (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.
365-121

	NAME	SIGN	DATE	NO.OF VAR.
DRN	M.VIJAYABHARATHI	N.P	28.02.07	-
CHD	D.DINAKARAN	D.D	28.02.07	
APPD	K.ARUNACHALAM	K.A	28.02.07	

DEPT	SCALE	WEIGHT (KG).	REFERENCE INFORMATIONS	NO. OF ITEMS
VL	NTS	-		-
CODE: -				

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET

CARD CODE: U 01

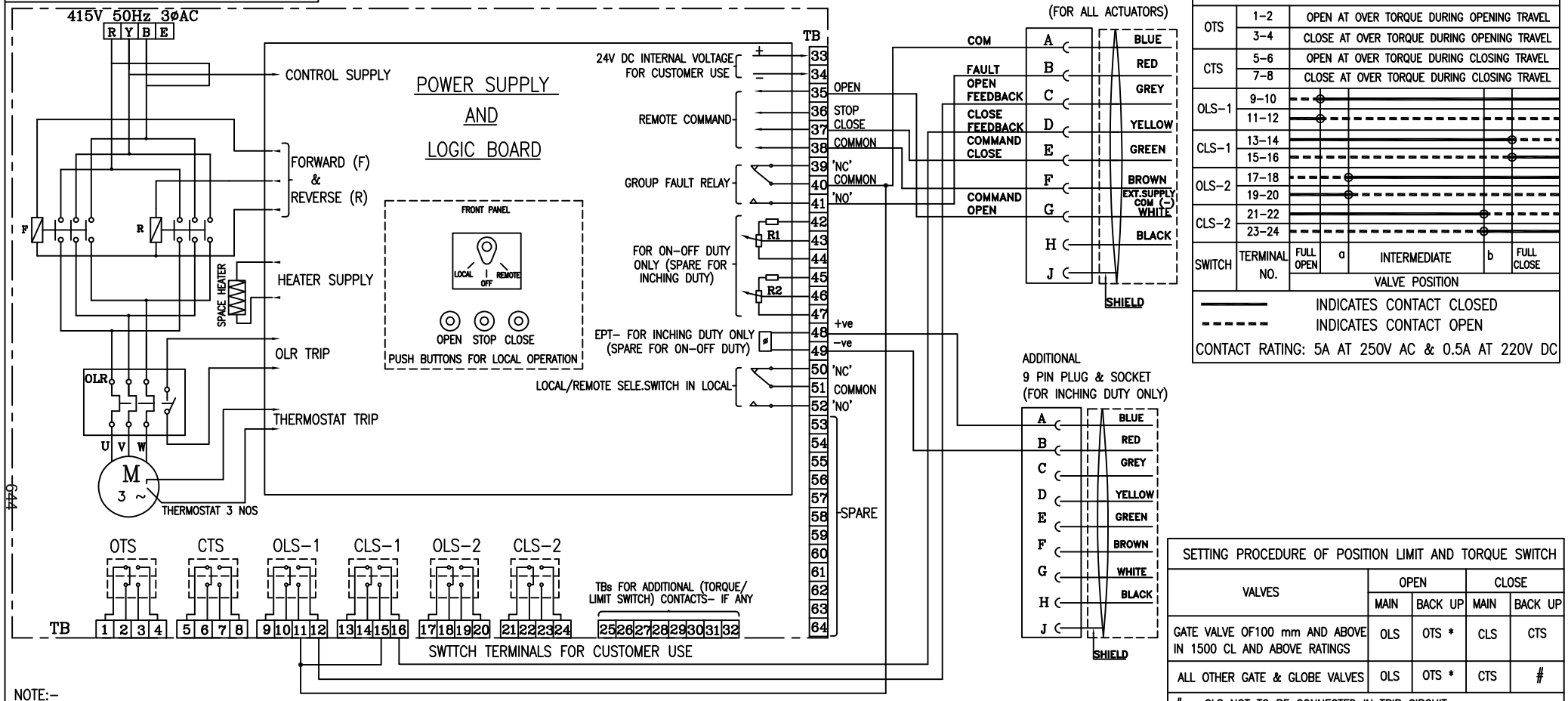
DRAWING NO.: 3-V-MISC-24550

REV: 0

Size A3

643

DRAWING NO. 3-V-MISC-24283



CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	

SWITCH TERMINAL NO. — FULL OPEN | a | INTERMEDIATE | b | FULL CLOSE — VALVE POSITION

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#

\# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

* - BYPASS OTS FOR INITIAL 5% OF TRAVEL(FOR GATE VALVES ONLY)

NOTE:-

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
2. CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
6. EPT - ELECTRONIC POSITION TRAMSMITTER (CONTACTLESS TYPE, FOR INCHING DUTY)
7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M - MOTOR 3ø 415V 50 Hz AC SUPPLY
10. TORQUE SWITCH BYPASS WITH LIMITSWITCH BOTH ON OPEN & CLOSE DIRECTION TO BE DONE INTERNALLY.

REV	DATE	ALTERED
		CHD & APPD

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS FOR NTPC PROJECTS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.
365-121

	NAME	SIGN	DATE	NO.OF VAR.
DRN	N.P.ESWAR	N.P	17.03.05	-
CHD	D.DINAKARAN	D.D	17.03.05	
APPD	K.ARUNACHALAM	K.A	17.03.05	

DEPT	SCALE	WEIGHT (KG).	REFERENCE INFORMATIONS	NO. OF ITEMS
VL	NTS	-		-
CODE -				

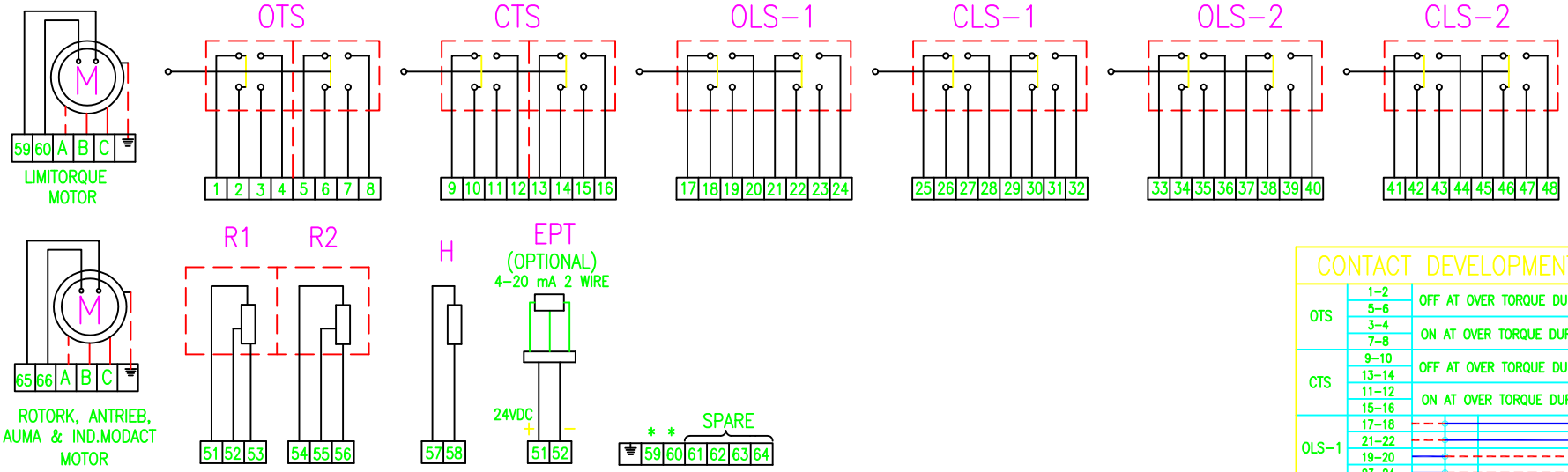
TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET FOR NTPC PROJECTS

CARD CODE: U 01

DRAWING NO. 3-V-MISC-24283

REV 0

Size A3



* – SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT

SWITCHES – ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY

THERMOSTAT – 65–66 (ROTORK, AUMA, ANTRIEB & IND.MODACT), 59–60 (LIMITORQUE).

EPT – ELECTRONIC POSITION TRAMSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)

THERMOSTAT TERMINALS – TERMINATED IN MOTOR TB IN ANTRIEB & IND.MODACT AND IN MAIN TB IN OTHER MAKES

CTS – TORQUE SWITCHES FOR CW ROTATION (CLOSE) – 2 NO+2 NC

OTS – TORQUE SWITCHES FOR CCW ROTATION (OPEN) – 2 NO+2 NC

OLS–1, OLS–2 – LIMITSWITCHES FOR POSITION OPEN – 2 NO+2 NC

CLS–1, CLS–2 – LIMITSWITCHES FOR POSITION CLOSE – 2 NO+2 NC

OTS, CTS – TWO INDEPENDENT SWITCHS IN ANTRIEB & LIMITORQUE

OLS–2 & CLS–2 – CAM DISC IN ROTORK & ANTRIEB

R1–R2– POTENTIOMETER 2 x 100 OHMS

H – SPACE HEATER 1ø 240V AC SUPPLY

M – MOTOR 3ø 415V 50 Hz AC SUPPLY

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

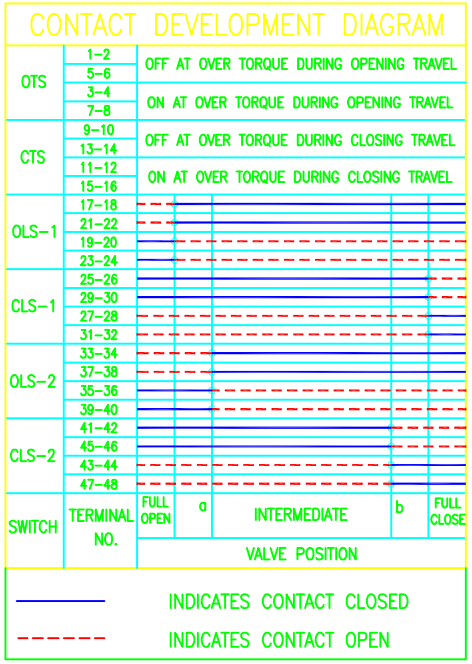
VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS	CTS	@

@ – CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

NOTE:

1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

CONTACT DEVELOPMENT DIAGRAM



CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

REV	DATE	CHED	APPD	DESCRIPTION
11	09.09 2000			CONTACT DEV. FIG.ADDED.

365-139

BHARAT HEAVY ELECTRICALS LTD.
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI 620014.

DRAWN	N.P.ESWAR
CHECKED	K.ARUNACHALAM
APPROVED	P.LOGANATHAN
DATE	09.09.2000

TITLE

INTERNAL WIRING DIAGRAM
FOR
ELECTRICAL VALVE ACTUATORS (AC)
(DRAWN FOR INTERMEDIATE POSITION OF VALVES)

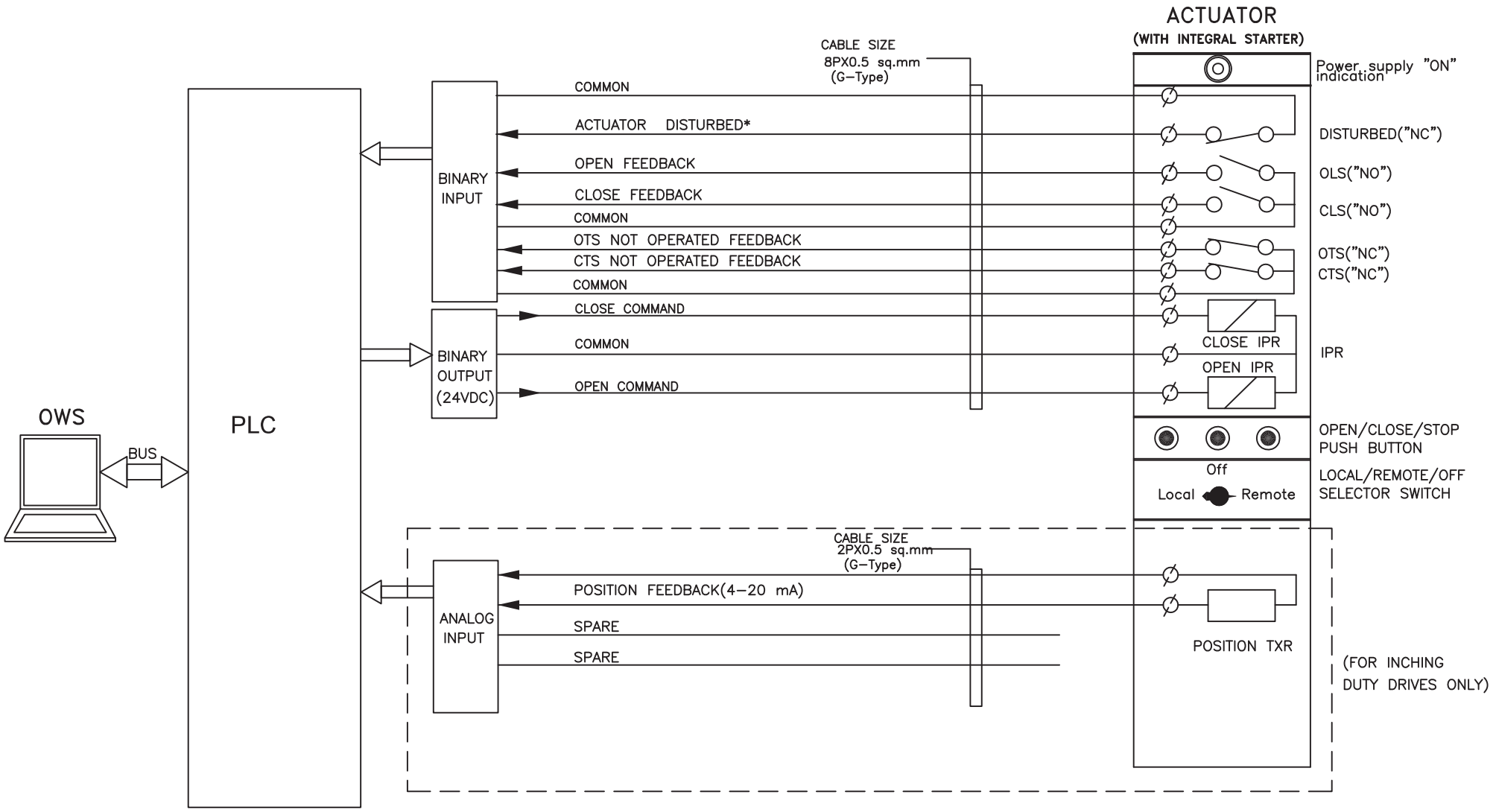
DRAWING No. 4-V-MISC-90271 REV 11

RETRACED WITH REVISION 11

645

Drive Control Philosophy

PLC INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)

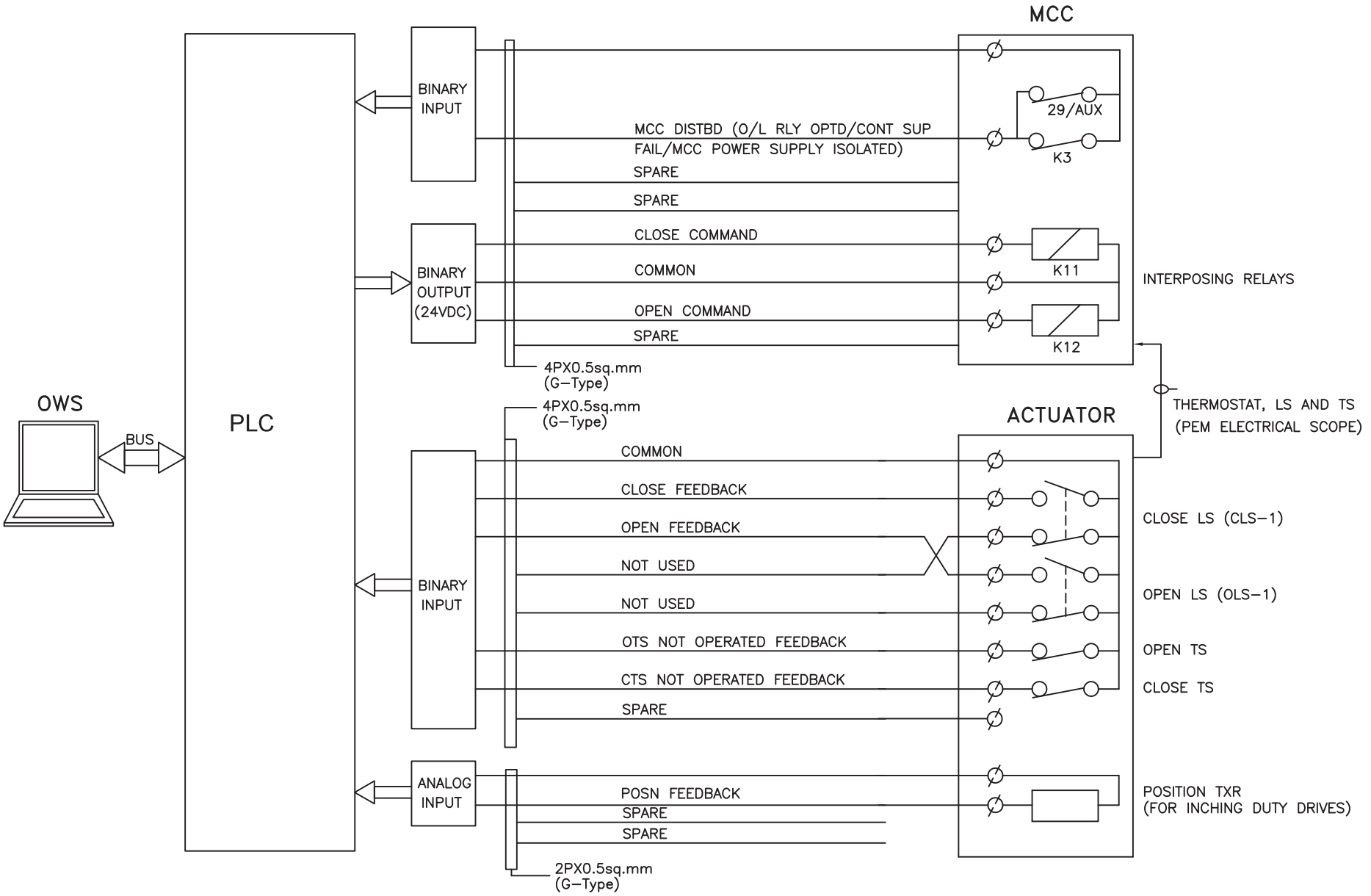


NOTE:

* DISTURBED= Loss of Power supply (1 Phase/3 Phase)/
Loss of control supply/ Motor thermostat trip/
Thermal over load/
Local/Off/Remote Sel. switch in local or off mode/
Stop PB optd.

BHEL	PROJECT:	DRG.NO.	PE–SD–999–145–I002
		DATE	12.02.2013
	TITLE DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	03
		SHT	7 OF 12

ANNEXURE–A PLC INTERFACE FOR BIDIRECTIONAL DRIVE(WITH MCC)



BHEL	PROJECT:	DRG.NO.	PE–SD–999–145–I002
		DATE	07.02.2013
	TITLE DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	03
		SHT	7 OF 12

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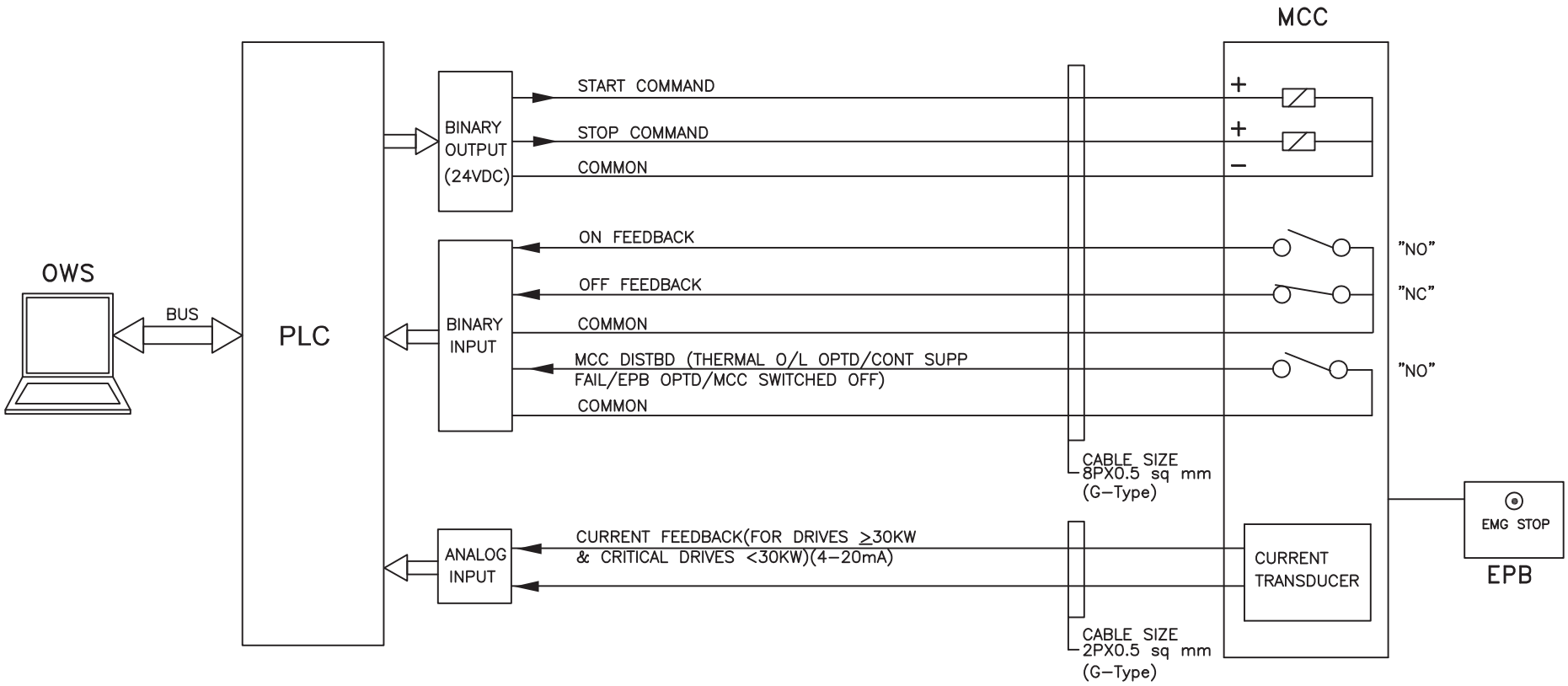
L16

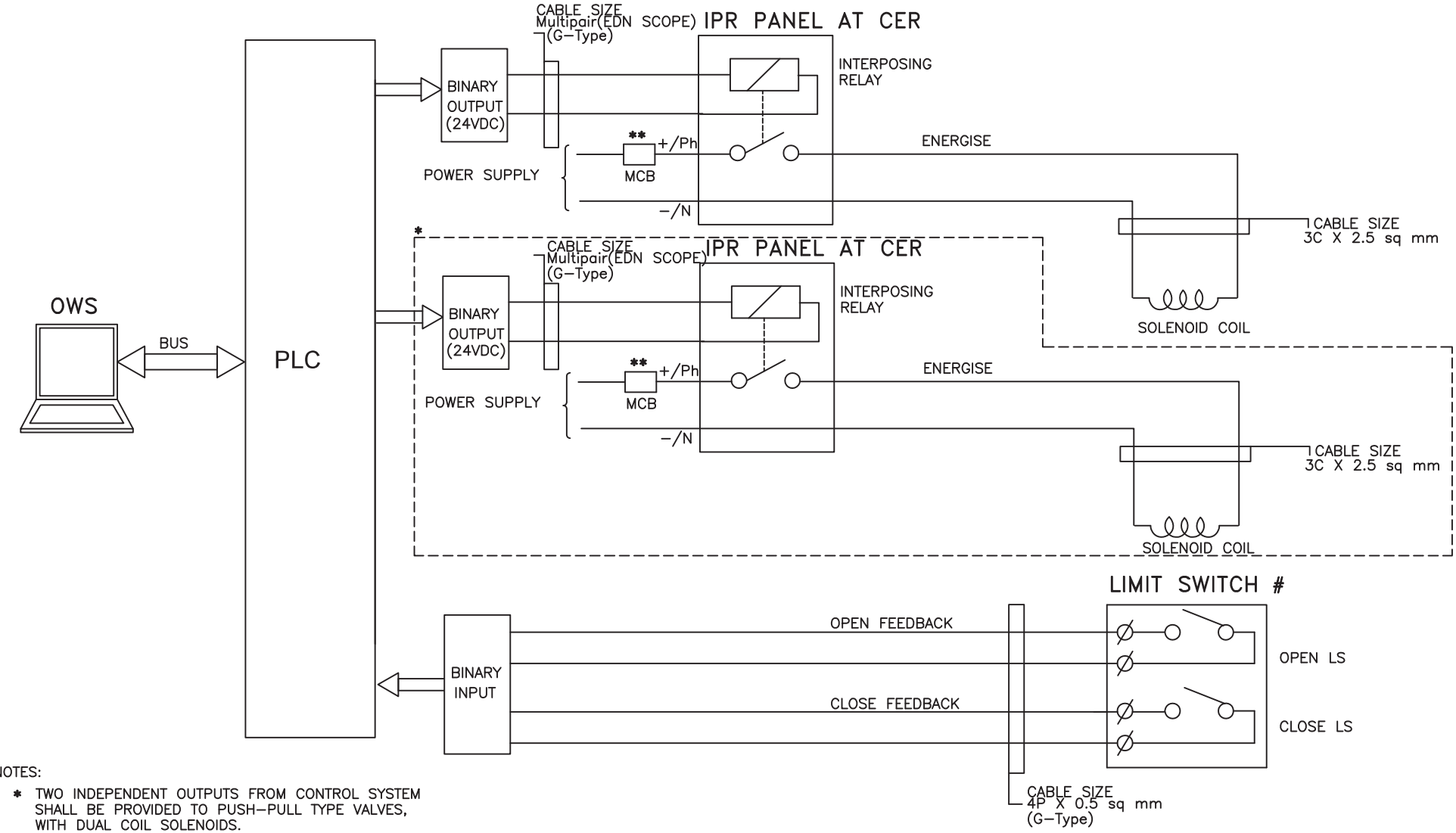
PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE



649

BHEL	PROJECT:	DRG.NO.	PE-SD-999-145-I002
		DATE	12.02.2013
	TITLE DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	REV.NO.	03
		SHT	8 OF 12

PLC INTERFACE FOR SOLENOID DRIVE
(24V DC / 240V AC UPS)



NOTES:

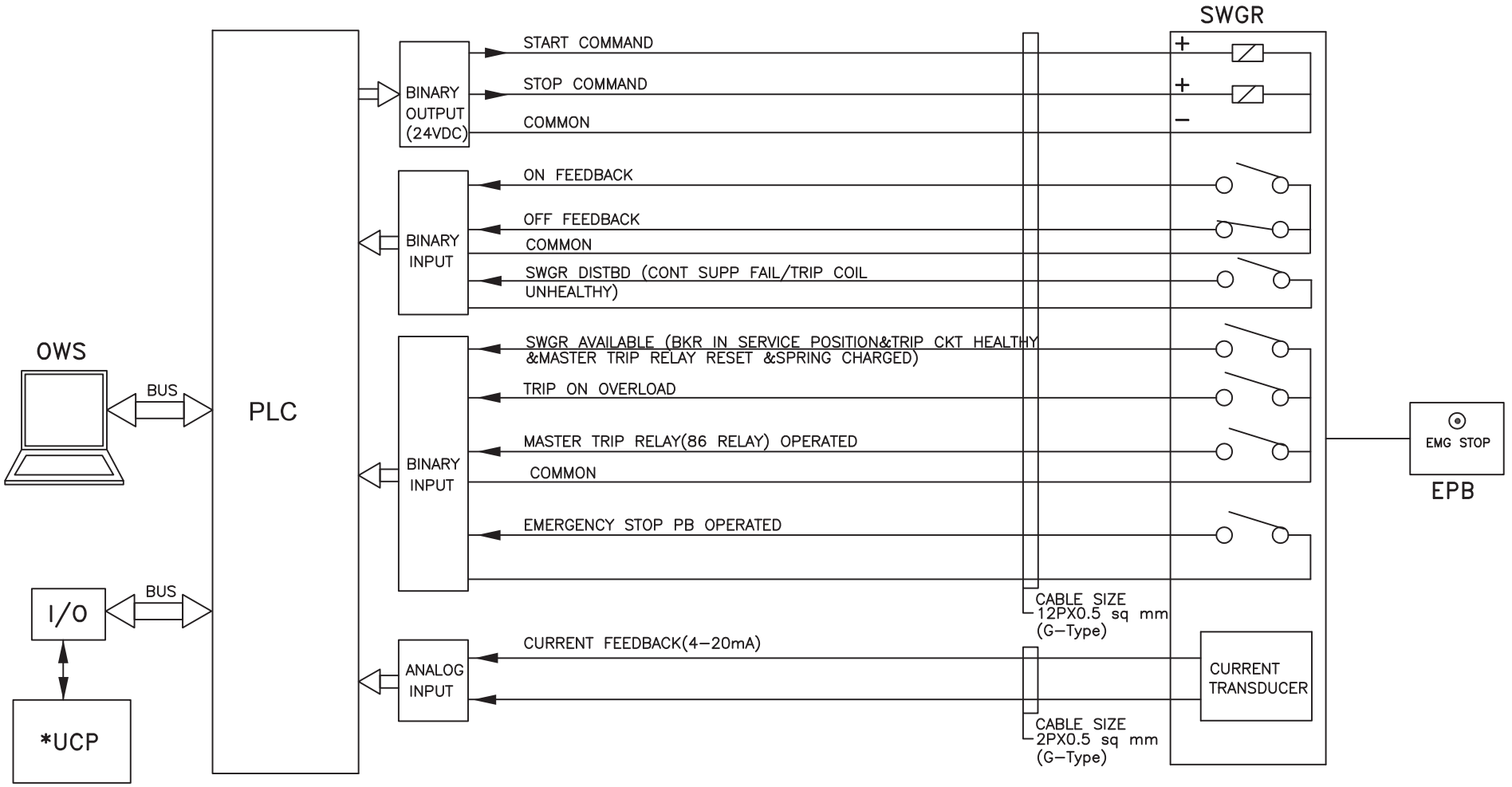
* TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH–PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

\# FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

BHEL	PROJECT:	DRG.NO.	PE–SD–999–145–I002
		DATE	12.02.2013
	TITLE DDCMIS INTERFACE FOR SOLENOID DRIVE	REV.NO.	03
		SHT	9 OF 12

PLC INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)

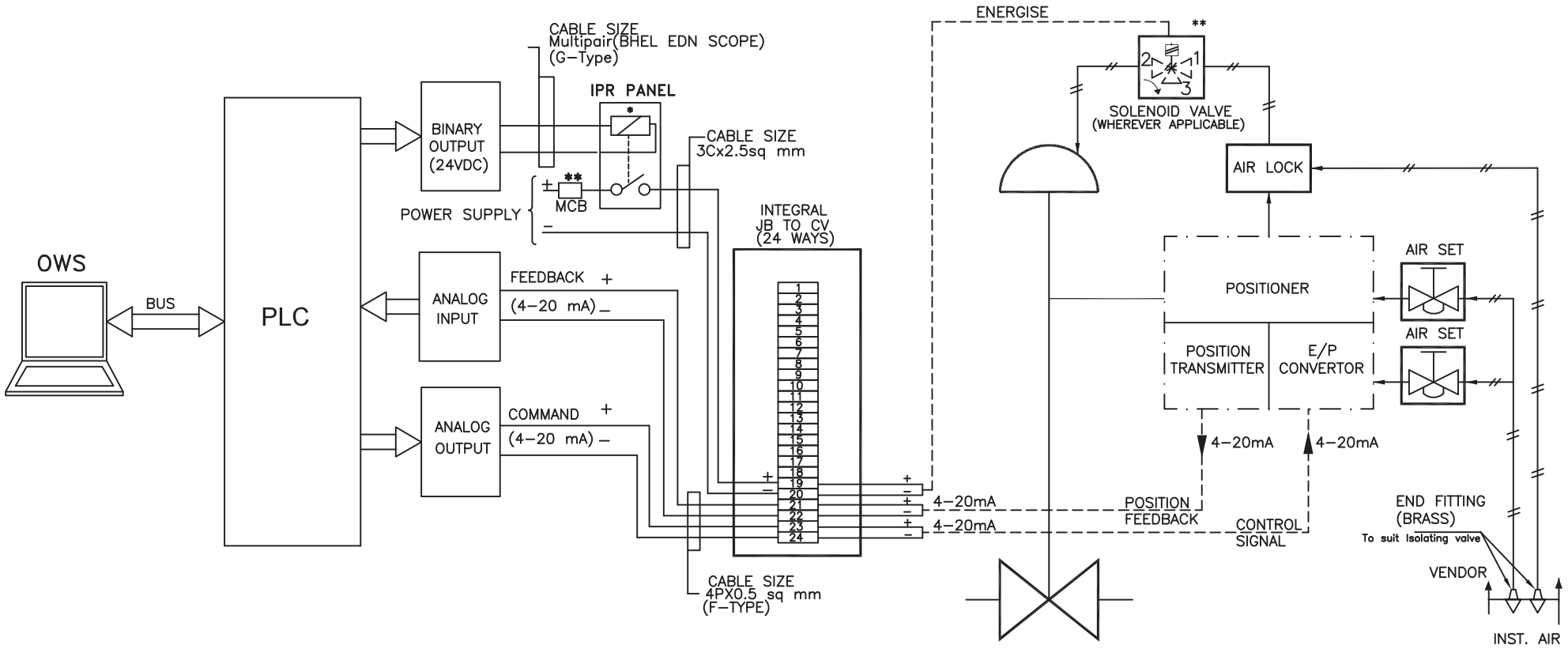


NOTE:

*WHEREVER APPLICABLE

BHEL	PROJECT:	DRG.NO.	PE–SD–999–145–I002
		DATE	12.02.2013
	TITLE DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	REV.NO.	03
		SHT	10 OF 12

PLC INTERFACE FOR ANALOG DRIVE



652

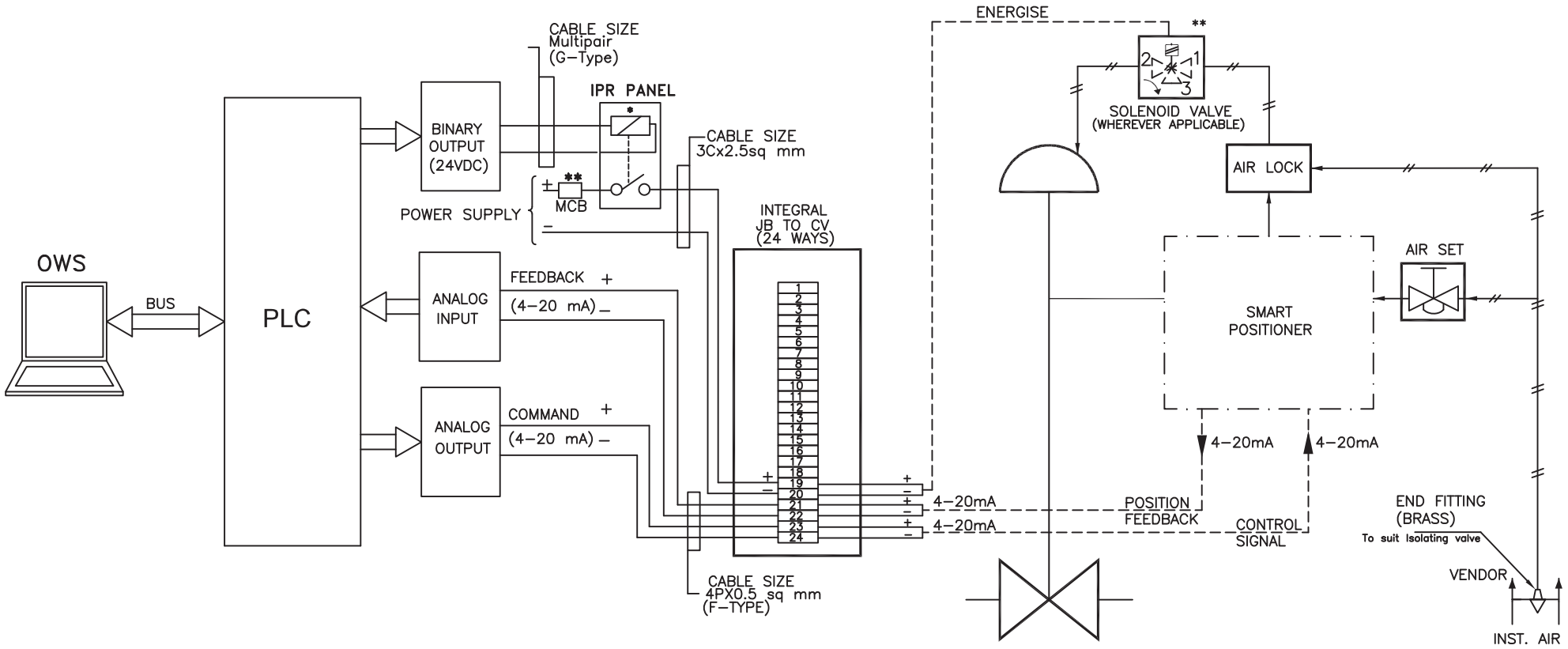
NOTES:

* APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

भेल BHEL	PROJECT:	DRG.NO.	PE–SD–999–145–I002
		DATE	12.02.2013
	TITLE TYPICAL HOOK–UP DIAGRAM ANALOG DRIVE	REV.NO.	03
		SHT	11 OF 12

PLC INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)

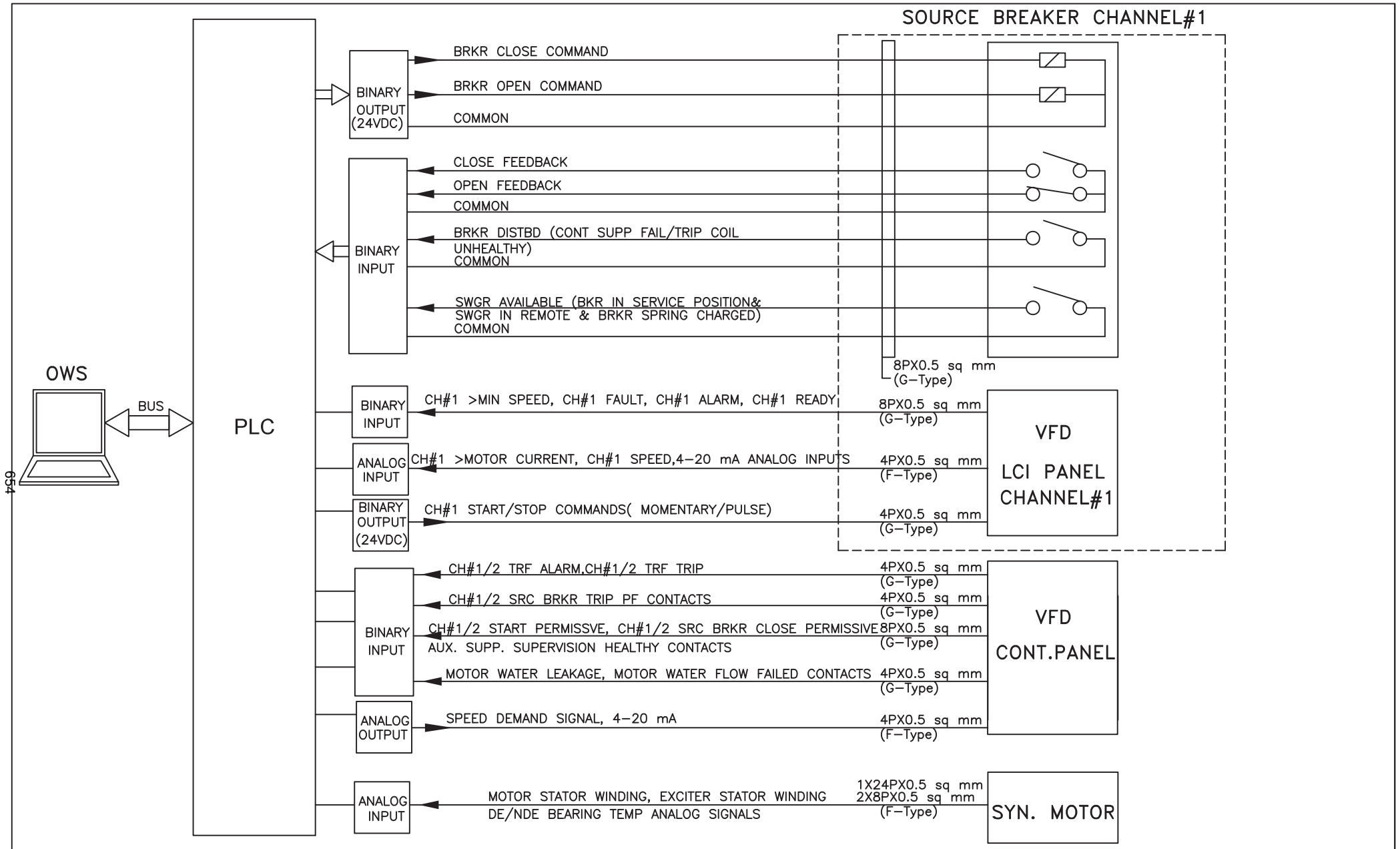


NOTES:

** APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.

BHEL	PROJECT:	DRG.NO.	PE–SD–999–145–I002
		DATE	07.02.13
	TITLE: TYPICAL HOOK–UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	REV.NO.	03
		SHT	11A OF 12

PLC INTERFACE FOR VFD CONTROL DRIVE



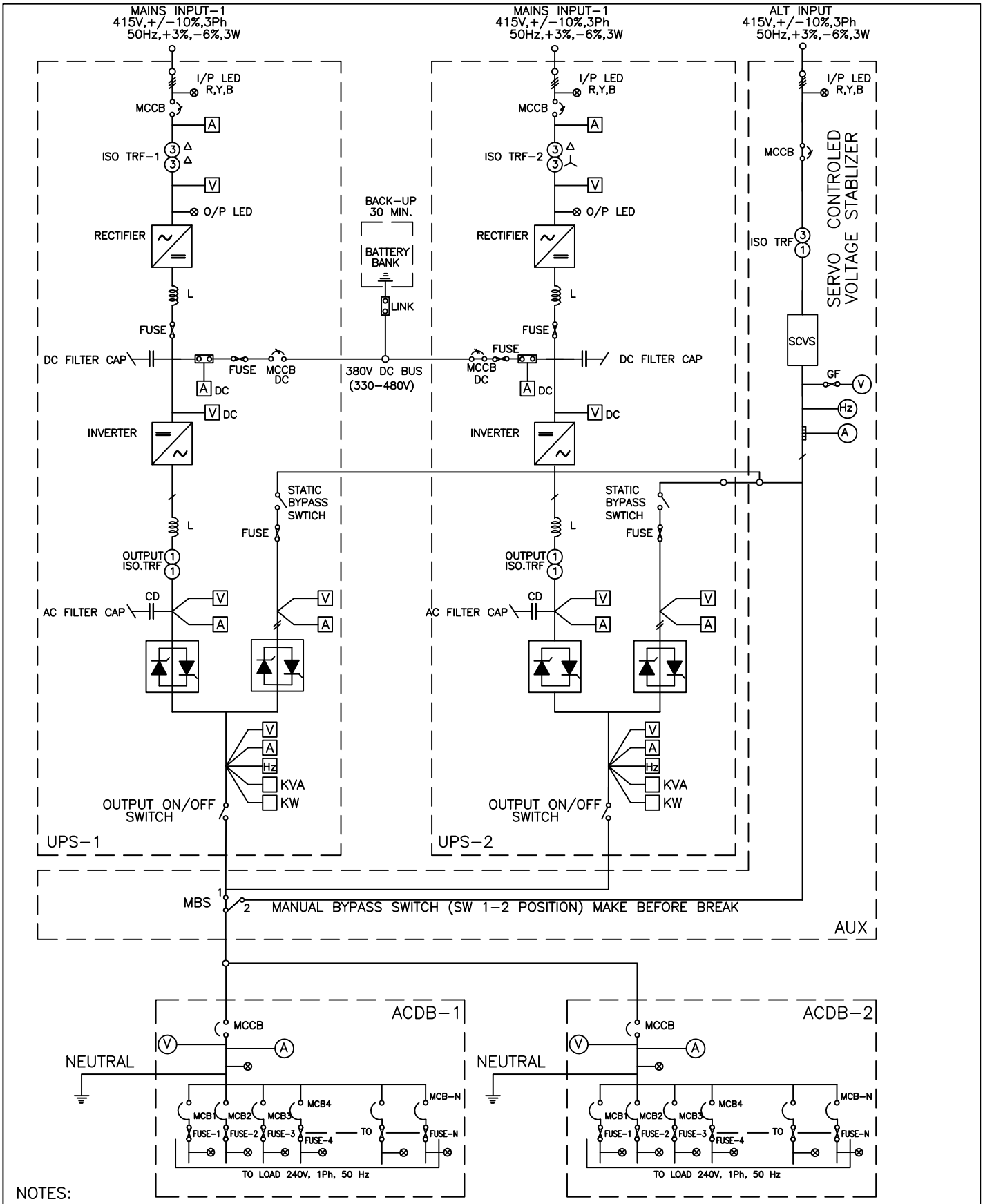
NOTES:

1. SIGNAL INTERFACE FOR CH#2 SRC BRKR AND VFD LCI PANEL SHALL BE IDENTICAL TO CH#1 AS INDICATED IN DOTTED PORTION.

भेल BHEL	PROJECT:	DRG.NO.	PE-SD-999-145-I002
		DATE	07.02.2013
	TITLE DDCMIS INTERFACE FOR VFD DRIVE	REV.NO.	03
		SHT	12 OF 12

STANDARD UPS
SINGLE LINE DIAGRAM

JOB NO. 999					PROJECT	STANDARD					
STATUS STANDARD											
PRINT SCALE 0 2 4 6 8 10 20 30 40 50					BHEL	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI	DEPT CODE	DRN	NAME GA	SIGN	DATE 30.09.09
REV	DATE	ALTD	CHKD	APPD			I	DESN	VS		30.09.09
								CHD	SSB		30.09.09
								APPD	AK		30.09.09
					TITLE :- STANDARD UPS SINGLE LINE DIAGRAM						
							DEPT.	SCALE	DRAWING/DOC. NO. PE-DG-999-145-I004		
							SIGN				
							DATE		SHEET 1 OF 2		REV. 00



NOTES:

1. ACDB-1&2 NEUTRAL TO BE GROUNDED TO A DEDICATED GROUND.
2. ALL OUTPUT FEEDERS OF ACDB SHALL BE PROVIDED WITH AN LED AFTER THE FUSE FOR FEEDER ON INDICATION WITH FEEDER DESCRIPTION.
3. REDUNDANT FEEDERS SHALL BE LOCATED IN DIFFERENT ACDBs.

BHEL	STANDARD	DRG. No.	PE-DG-999-145-I004
	TITLE:- UPS SINGLE LINE DIAGRAM	REV. No. 00	DATE 01.10.2009
		SHEET 2 OF 2	

INSTRUMENTATION DATA SHEET

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 1 OF 4	

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE	☐ INDUCTANCE ☐ CAPACITANCE ☐ STRAIN GAUGE ☐	
	POWER SUPPLY	24V DC	
	TRANSMITTER MEASUREMENT	☐ PRESSURE ☐ DIFF. PRESSURE	
	OUTPUT SIGNAL	4-20MA	
	NO. OF WIRE	TWO	
	ACCURACY	± 0.5% OF SPAN	
	LINEARITY, HYSTERISIS, DEAD BAND AND REPEATABILITY	± 0.1% OF SPAN	
	STABILITY	± 0.25% OF SPAN OR BETTER FOR 6 MONTHS	
	SENSITIVITY	± 0.05% OF SPAN	
	MATERIAL		
	A) BODY	FORGED CARBON STEEL	
	B) ELEMENT	316 SS	
	C) SEAL	TEFLON	
	CONTINUOUSLY ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	☐ YES ☐ NO	
	MOUNTING	☐ WALL/PIPE STAND ☐ TRANSMITTER RACK	
	ENCLOSURE	☐ NEMA-4 ☐ NEMA-7	
	TURN DOWN RATIO	TO BE SPECIFIED BY BIDDER	
	INSULATION RESISTANCE	TO BE SPECIFIED BY BIDDER	
	ZERO SUPPRESSION RANGE	TO BE SPECIFIED BY BIDDER	
	ZERO ELEVATION RANGE	TO BE SPECIFIED BY BIDDER	
	INTEGRAL INDICATOR	☐ YES ☐ NO	

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 2 OF 4	

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	TRANSMITTER SHALL BE ABLE TO DRIVE OUTPUT IMPEDANCE OF 500 OHMS.	YES	
	ZERO DRIFT	< 0.1%	
	SPAN DRIFT	< 0.1%	
	MANIFOLD		
	a) PRESSURE MEASUREMENT	3 WAY	
	B) DIFFERENTIAL PRESSURE MEASUREMENT	5 WAY	
	CABLE ENTRY DETAIL	SUITABLE FOR DIA OF 17.5 mm	

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR TEMPERATURE ELEMENT (WITH THERMOWELL)	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PES-145-03-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR TEMPERATURE ELEMENT (WITH THERMOWELL) (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	ELEMENT TYPE	☐ RTD (3 WIRE) ☐ T / C	
	T / C GROUNDED	☐ YES ☐ NO	
	ELEMENT THICKNESS (AWG)		
	LIMIT OF ERROR		
	INSULATION RESISTANCE	MORE THAN 5M OHM AT 100V DC	
	TIME CONSTANT		
	MOUNTING THREAD SIZE		
	CONDUIT THREAD SIZE		
	EXTENSION WIRE TYPE		
	THERMOWELL	☐ YES ☐ NO	
	THERMOWELL LENGTH		
	LINE SIZE		
	PRESSURE RATING		
	TEMPERATURE RATING		

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR LEVEL TRANSMITTER (DISPLACEMENT TYPE)	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE: 19.12.95
		SHEET 1 OF 1	

TAG No. ……. Qty..... Data Sheet No.: **PES-145-08-DS1-0**

Data Sheet A & B

DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER		
	MODEL NUMBER		
	SERVICE		
	OPERATING PRESSURE & TEMP.		
	LEVEL RANGE		
	B) MAX. OPERATING TEMPERATURE		
	RANGE		
TECHNICAL	TYPE	☐ DIRECT ☐ REVERSE	
	POWER SUPPLY	24V DC	
	OUTPUT SIGNAL	4-20mA	
	NO. OF WIRE	TWO	
	ACCURACY	± 1% OF SPAN AT SP. GR. OF 1	
	LINEARITY AND HYSTERISIS	± 1.0 %	
	REPEATABILITY	± 5.0 %	
	GLASS TUBE / GLASS PLATE	BOROSILLICATE TOUGHENED	
	MATERIAL:		
	A) CAGE	☐ FORGED CARBON STEEL ☐ 316 SS	
	B) DISPLACER	☐ 304 SS ☐ 316 SS	
	C) LINKAGE & TORQUE TUBE	☐ SS-316	
	CONTINUOUS ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	YES	
	ZERO & SPAN ADJUSTMENT ARE INDEPENDENT & NON INTERACTIVE	YES	
	MOUNTING	☐ TOP & BOTTOM ☐ SIDE & SIDE ☐ TOP & SIDE ☐ BOTTOM & SIDE	
	END CONNECTION	CENTRE TO CENTRE DISTANCE: CONNECTION FLANCE SIZE: ANSI CLASS: MATERIAL:	
	ENCLOSURE	IP-65	
	OUTPUT INDICATOR	☐ YES ☐ NO	
	BODY RATING	ANSI CLASS :	
	ACCESSORIES	MATING FLANGE WITH NUTS & BOLTS AND GASKET	
	CABLE ENTRY DETAILS	SUITABLE GLAND (DOUBLE COMPRESSION) FOR MAXIMUM CABLE DIA OF 17.5mm	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR LEVEL SWITCHES (FLOAT / DISPLACER TYPE)	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 1

TAG No. …… Data Sheet No.: **PES-145-33-DS1-0**

Data Sheet A&B

DESCRIPTION		Data Sheet-A (To be filled in by Purchaser)	Data Sheet-B (To be filled in by bidder)
GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE	☐ TOP MOUNTED ☐ SIDE MOUNTED (with/without external chamber) ☐ DISPLACER TYPE ☐ FLOAT OPERATED ☐ EXTERNAL CHAMBER	
	MATERIAL	FLOAT ASSEMBLY SS ANSI 316	
	DISPLACER	AISI 316	
	WIRE ROPE	AISI 316	
	SLEEVE PIPE	AISI 316	
	EXTERNAL CHAMBER	☐ CS WELDED CONST. ☐ SS WELDED CONST. ☐ AS WELDED CONST.	
	SWITCH HOUSING GASKET	☐ AISI 304 SS ☐ DIE C AST ALUMINIUM ☐ NEOPRENE ☐ TEFLON	
	ENCLOSURE	☐ SWITCH HOUSING NEMA-4 ☐ FUEL GAS HAZARDOUS APPL. EXPL. PROOF	
	TYPE OF SWITCH	SNAP ACTING MEGNETICALLY OPERATED	
	CONTACT RATING	☐ YES ☐ CHAMBER DRAIN ½" NPT PLUG	
	ISOLATION VALVE	☐ YES ☐ NO	
	SP. GR. OF FLUID	0.70 TO 1.2	
	DIFF. BETWEEN MAKE & BREAK OF SWITCH	☐ 12 ±2 mm (SIDE MOUNTED) ☐ 35 ±3 mm (TOP MOUNTED) ☐ ADJUSTABLE	
	MAXIMUM PRESSURE RATING		
	MAXIMUM TEMPERATURE RATING		
PERFORMANCE	REPEATABILITY	±1mm	
CONNECTION	EXT. CHAMBER CONNECTION	1" NB SOCKET WELD (TOP AND BOTTOM)	
	ELECT.	COMPLETE WITH CABLE GLAND TO SUIT CABLE WITH MAXIMUM 17.5mm O.D.	
ACCESSORIES	INSTALLATION ACCESSORIES	AS REQUIRED.	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

	SPECIFICATION FOR TEMPERATURE GAUGE	SPECIFICATION NO.: PES – 145 – 027	
		VOLUME II B	
		SECTION D	
		REV. NO. 00	DATE : 23-04-2010
		SHEET 1	OF 3

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 of Temperature Gauge for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

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

Enclosure	-	ISA: RP:8.1
Thermowell	-	ASME : PTC-19.3

3.0 TECHNICAL REQUIREMENTS

3.1 General

The thermometers shall be suitable for an ambient temperature of 0-55°C and relative humidity of 0-95%.

3.2 Bourdon tube and movement

Bourdon shall be made of suitable AISI 316 and the movement shall conform to AISI 304.

3.3 Case

Shall be made of Die cast aluminium and painted with Black stoving enamel paint over a suitable etch primer.

3.4 Bezel Ring

Shall be made of anodised aluminium with anti corrosive finish.

3.5 Dial and Scale

The dial shall be made of suitable material with anti corrosive finish.

The scale shall be concentric and graduated in degrees centigrade. The markings shall be in black on a non-reflective white background.

The pointer deflection angle shall be 270 degrees.

The unit of measurement Deg.C shall also be marked on the dial.

3.6 Pointer

Shall be made of suitable metal with black finish. The pointer shall be provided with suitable mechanism for zero adjustment without opening the case.

3.7 Bulb and Stem

Bulb and stem shall be made of stainless steel AISI 316. The bulb O.D. shall be 12 $\pm$0.1 mm. The process connection shall be adjustable gland type. The immersion length shall be adjustable between 100mm to 300mm. The material of the adjustable gland is AISI 316. The stem shall be flexible suitable for bending.

3.8 Temperature compensation

The thermometer shall be provided with compensating arrangement for ambient temperature changes.

3.9 Capillary

Capillary shall be SS-316 and 1.5mm dia, covered with 4.5mm dia of SS Spiral Sheath.

3.10 Accuracy

± 1% of the full-scale deflection.

3.11 Mounting & Connection

Flush Mounting, back connection, clamp fixing, Direct mounting bottom connection.

3.12 Thermowell

Gauge shall be supplied along with the thermowell. The thermowell shall be of AISI 316 SS/Cr.Mo. Steel and shall be designed to suit the process conditions. For details of the thermowell see enclosed drawings for Thermowell.

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 The following test shall be conducted as a minimum requirement.

a) Routine Tests

i) Accuracy test.
ii) Overload test
iii) Response time test

b) Type Tests

i) Ambient temperature compensation test.
ii) Weather proof water tight and dust tight tests.

4.3 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3 (b), "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House / Laboratory approved by BHEL.

4.4 The Standard QP is included in this specification to enable bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed QP, taking care of customer requirements mentioned in Sec-C and submit QP for final approval by BHEL / Customer.

5.0 SPARES AND CONSUMABLES

5.1 Recommended Spares

The bidder shall furnish a list of Recommended Spares alongwith 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 seperate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

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

6.1.1 Data sheet-B, completely filled-up alongwith all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogs with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and despatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/Installation drawings.

ii) Data sheet-C, completely filled-up alongwith all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final / As-built drawings / CDs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, 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.

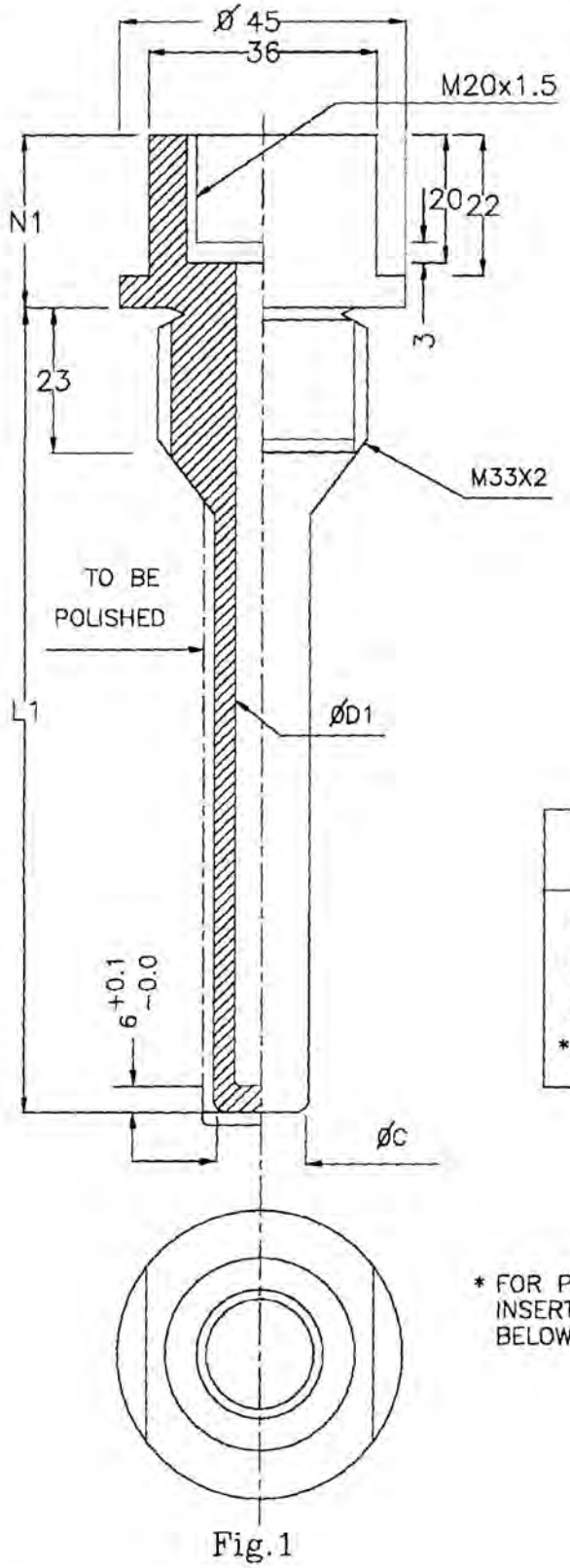
8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Temperature Gauge : Data sheet no. PES-145-27-DS1-1
- Data sheet C for Temperature Gauge : Data sheet no. PES-145-27-DS2-1

FORM NO. PEM - 6666-D

	THERMOWELL MEDIUM PRESSURE (40 Kgf/Cm2)	SPECIFICATION NO PES-145-27
		VOLUME IIB
		SECTION D
		REV. NO. 02 DATE 16-5-2007
		SHEET 4 OF 8



PIPE O.D.	INSERTION LENGTH (L1)
Ø 509 & ABOVE	325
Ø 506 TO 369	250
Ø 368 TO 274	175
*Ø 273 BELOW	150

* FOR PIPE O.Ds UP TO 159mm THE THERMOWELL INSERTION WILL BE STRAIGHT. FOR PIPE O.Ds BELOW 159mm, THE INSERTION SHALL BE SLANT.

Fig.1

FORM NO. PEM - 8666-0

BHEL	THERMOWELL-HIGH PRESSURE (250 Kgf/Cm2)	SPECIFICATION NO. PES-145-27 VOLUME IIB SECTION D REV. NO. 02 DATE 16-5-2007 SHEET 5 OF 8

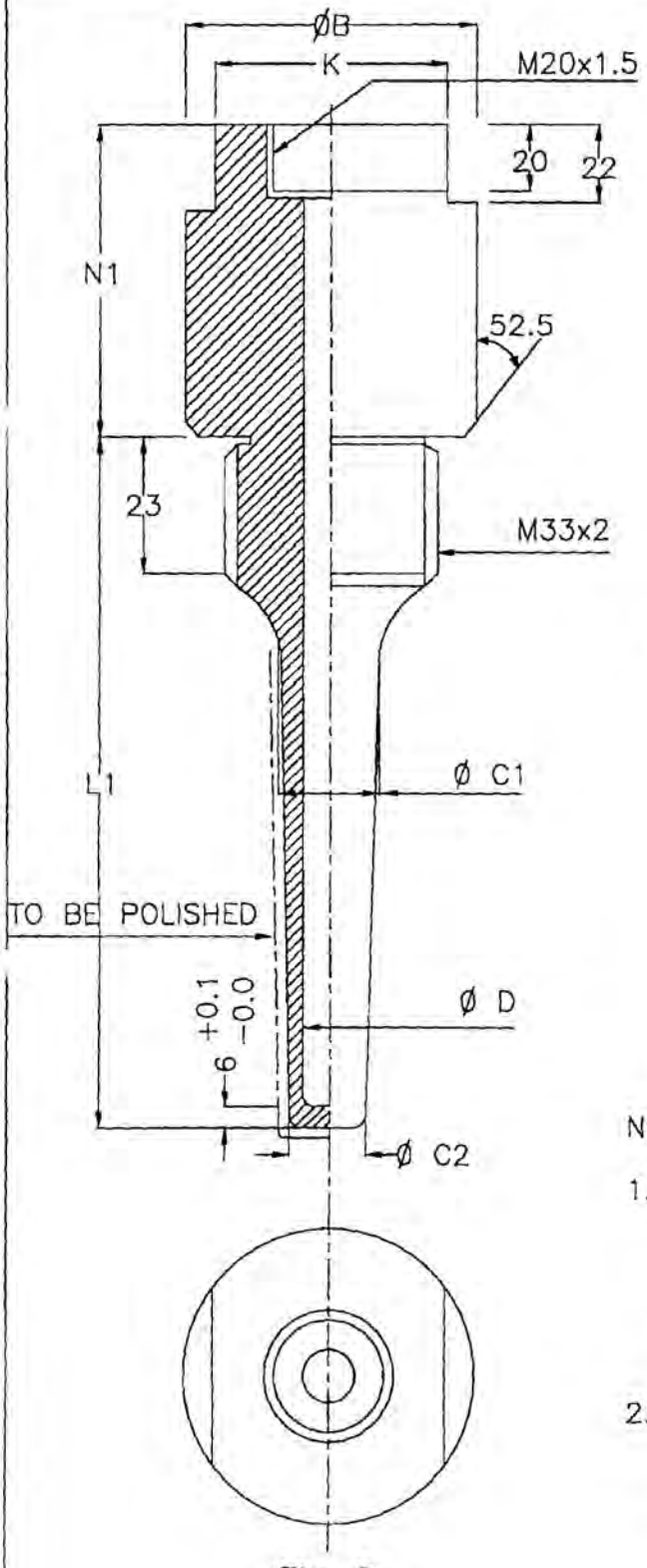


Fig. 2

PIPE O.D.	INSERTION LENGTH L1
Ø 509 & ABOVE	325
Ø 508 TO 368	250
Ø 367 TO Ø274	175
Ø 273 BELOW	150

NOTE :-

1. THE CORRESPONDING ELEMENT ELEMENT LENGTHS ARE GIVEN FOR INFORMATION ONLY. THE ELEMENT LENGTHS ARE WORKOUT AS PER THE FORMULA L=L1+N1-6.

2. FOR PIPE OD'S UPTO 159mm, THE THERMOWELL INSERTION WILL BE STRAIGHT. FOR PIPE OD'S BELOW 159mm, THE INSERTION SHALL BE SLANT.

FORMAT NO. - 6666-0

भेल BHEL	**SPECIFICATION FOR TEMPERATURE GAUGE**	SPECIFICATION NO. : PES - 145 - 27 VOLUME II B SECTION D REV. NO. 02 DATE 16-5-2007 SHEET 6 OF 8

ALL DIMENSIONS IN mm

Instrument stem dia D+0.0 -0.1	DIA D1 +0.2 0	DIA C	Insertion Length L1	Extention element length N1	Corres ponding element length(L)
12	12.5	19	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419
14	14.5	21	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419

NOTE: The corresponding element lenghts are given for information only. The elements lengths are worked out as per the formula :

$$L = L1 + N1 - 6$$

	SPECIFICATION FOR TEMPERATURE GAUGE	SPECIFICATION NO. : PES - 145 - 27
		VOLUME II B
		SECTION D
		REV. NO. 02 DATE 16-5-2007
		SHEET 7 OF 8

THERMOWELL-MEDIUM PRESSURE
(40 KG/CM2)

ALL DIMENSIONS IN mm

Instrument stem dia D+0.0 -0.1	DIA D1 +0.2 0	DIA C	Insertion Length L1	Extention element length N1	Corres ponding element length(L)
6	6,5	12.5	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419
8	8.5	15	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419

	THERMOWELL HIGH PRESSURE (250 KGf/Cm²)	SPECIFICATION NO. : PES - 145 - 27
		VOLUME II B
		SECTION D
		REV. NO. 02 DATE 16-5-2007
		SHEET 8 OF 8

ALL DIMENSIONS IN mm

Instrument stem dia D (+0.0 -0.1)	DIA D1 (+0.2 0.0)	DIA C1	DIA C2	K	DIA B	Insertion Length L1	Extention Length N1	Corresponding Element Length (L)
6	6.5	19	12.5	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
8	8.5	21.5	15	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
12	12.5	25.5	19	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
14	14.5	27.5	21	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
16	16.5	29	23	46	55	150	27 75 100	171 219 244
						250	27 75 100	271 319 344

FORM NO. PEM-6666-0

	TECHNICAL REQUIREMENT FOR TEMPERATURE GAUGE	SPECIFICATION NO.: VOLUME SECTION REV. NO. | DATE: SHEET 1 OF 1

TAG No. …… Qty……. Data Sheet No.: **PE-DC-326-145-I027-1**

Data Sheet A & B

DATA SHEET-A FOR TEMPERATURE GAUGE (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER		
	MODEL NUMBER		
	STANDARD TO BE FOLLOWED	■ ISA:RP:8.1 (ENCLOSURE) ■ ASME: PTC-19.3 (THERMOWELL)	
TECHNICAL	TYPE	MERCURRY FILLED (FOR <450 DEG C) INERT GAS ACTUATED (FOR >450 DEG C)	
	PRESSURE ELEMENT	BOURDON	
	MATERIAL	PRESSURE ELEMENT: ■ SS 316 (FOR Hg IN STEEL) CASE: ■ DIE CAST AL ■ SS BULB & CAPILLARY: SS 316 MOVEMENT: SS 304	
	DIAL	SIZE: 150 MM COLOR: WHITE NUMERALS: BLACK SCALE: LINEAR, 270° ARC GRADUATED IN DEG C	
	CASE	COLOUR : BLACK (IN CASE OF DIE CAST AL CASING)	
	ENCLOSURE	CLASS: ■ IP 55 PAINT: ■ EPOXY (IN CASE OF DIE CAST AL CASING)	
	MOUNTING	■ LOCAL ■ PANEL OR RACK	
	ZERO ADJUSTMENT	REQUIRED	
	RANGE SELECTION	SHOULD COVER 125% OF OPERATING PARAMETER	
	OVER RANGE PROTECTION	125% OF FSD FOR RANGE UPTO 400 Deg C 110% OF FSD FOR RANGE BETWEEN 400 TO 500 Deg C	
	COMPENSATION	CASE COMPENSATION TO BE PROVIDED AS PER BS 5235 FOR 0 TO 60 °C.	
	CAPILLARY MATERIAL	SS 316, 1.5 MM DIA COVERED WITH SS SPIRAL SHEATH OF 4.5 MM DIA	
	CAPILLARY LENGTH	5 MTR FOR LOCAL MOUNTED	
PERFORMANCE	ACCURACY	± 0.5% / ± 1% OR BETTER OF FULL SCALE DEFLECTION	
	RESPONSE TIME (WITHOUT THERMOWELL)	AS PER ASME PTC 19.3	
CONNECTION	CONNECTION WITH THERMOWELL	■ M20 x 1.5 (M) ■ 3/4" NPT (M) ■ ½" NPT(M)	
	LOCATION	BOTTOM / BACK	
THERMOWELL	MATERIAL (BAR STOCK)	■ SS 316	
	TYPE	■ SCREWED ■ WELDED ■ FLANGED	
	PROCESS CONNECTION	■ M33X2 ■ 150 RF ■ R 1 ■ R 1½	
	IMMERSION LENGTH (L1)	½ ID OF PIPE SUBJECT TO CONFORMANCE WITH ASME PTC 19.3	
	EXTENSION LENGTH (N1)	INSULATION THICKNESS - STUB HEIGHT + 25 MM	

	TECHNICAL REQUIREMENT FOR TEMPERATURE GAUGE	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 2 OF 1

TAG No. …… Qty……. Data Sheet No.: **PE-DC-326-145-I027-1**

Data Sheet A & B

DATA SHEET-A FOR TEMPERATURE GAUGE (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

ACCESSORIES	NAME PLATE / METAL TAG	ENGRAVED WITH SERVICE LEGEND OR PHINOLIC NAME PLATE		
OTHER REQUIREMENT	1. AMBIENT TEMPERATURE 0-55 DEG C, RH 0-95%. 2. BULB O.D. 12 ± 0.1 MM 3. BEZEL RING SHALL BE OF ANODIZED ALUMINIUM / ABS PLASTIC INCASE OF DIE CAST AL CASING 4. ADJUSTABLE GLAND (BETWEEN 100 MM TO 300 MM) OF SS316 TO BE PROVIDED FOR CONNECTION OF STEM WITH THERMOWELL			
	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME				NAME
SIGNATURE/DATE				SIGNATURE /DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 1

TAG No. ……. Qty..... Data Sheet No.: **PE-DC-999-145-I026-1**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	PRESSURE ELEMENT	☐ BOURDON ☐ DIAPHRAGM ☐ BELLOW	
	MATERIAL	SENSING ELEMENT – AISI 316 SS MOVEMENT – AISI 304 SS CASING – ☐ DIE CAST AL ☐ SS	
	ENCLOSURE	☐ INDOOR MOUNTED IP-55 ☐ OUTDOOR MOUNTED IP-67 ☐ FUEL GAS HAZARDOUS APPL. EXPL. PROOF	
	DIAL	SIZE: ☐ 100MM ☐ 150MM COLOR: WHITE NUMERALS: BLACK SCALE: ☐ LINEAR ☐ SQUARE ROOT	
	CASE	COLOUR : BLACK	
	ADJUSTMENT	☐ EXT. MICROMETER SCREW ☐ INT. MICRO SCREW	
	MOUNTING	☐ LOCAL ☐ PANEL OR RACK	
	OVER RANGE PROTECTION	115% ABOVE 150 KG/CM2 FSD 125% ABOVE 150 KG/CM2 FSD	
	BLOW OUT DISC	REQUIRED	
	SWITCHING FACILITY	☐ YES ☐ NO	
	TYPE	☐ MICRO SWITCH ☐ OTHER	
	NO. / TYPE OF CONTACTS	2 NOS. SPDT	
	CONTACT RATING	5A 230V AC, 0.25A 220V DC	
	SETTING RANGE	FIELD ADJUSTABLE OVER FULL RANGE	
	REPEATABILITY	± 1% OF FSR	
	POWER SUPPLY	230V AC (if required)	
PERFORMANCE	ACCURACY	± 1% OR BETTER OF FULL SCALE DEFLECTION	
CONNECTION	PROCESS	M20 x 1.5 (M)	
	LOCATION	☐ BACK ☐ BOTTOM	
ACCESSORIES	NAME PLATE / METAL TAG	SS	
	MOUNTING	☐ WALL ☐ PIPE – U CLAMPS & BOLTS ☐ PANEL / RACK	
	OTHER	AS PER ENCLOSED DIAGRAM	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

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 of Pressure/Differential Pressure Gauge for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

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

Pressure and vacuum gauges	-	IS-3624
Enclosure	-	IS-12063

3.0 TECHNICAL REQUIREMENTS

3.1 General

The gauges shall be suitable for an ambient temperature of 0-55°C and relative humidity of 0-95%.

3.2 Bourdon tube, Movement & Shank

Bourdon shall be made of stainless steel to AISI 316 and the teeth shall be polished to have frictionless movement without backlash. Movement material shall be AISI 304.I

3.3 Case

Shall be made of die cast ~~aluminium~~aluminum and painted with black stoving enamel paint over a suitable primer. The case shall be provided with a blowout disc, to safeguard the window glass.

3.4 Bezel Ring

Shall be made of anodized ~~aluminium~~aluminum with anti corrosive finish.

3.5 Dial & Scale

The dial shall be made of a suitable material with anti corrosive finish, meeting the requirements of IS-3624.

The scale shall be concentric and graduated in kg/sq.cm. in the pressure gauge. MM of Hg on vacuum side and kg/sq.cm on pressure side in case of vacuum / compound gauges. The marking shall be black on a ~~non-reflecting~~non-reflecting white background. The pointer deflection angle shall be 270 Deg.

The unit of measurement shall also be marked on the dial.

3.6 Pointer

Shall be made of suitable metal with black finish. The pointer shall be provided with suitable mechanism for zero adjustment without opening the case.

3.7 Switch device

Switch device shall be snap acting micro switch. The rating of contact shall be 5 A 230 V AC, 0.25 A 220 V DC. Setting range shall be field adjustable over the full range.

3.8 Accuracy

±1% of the full scale deflection.

3.9 Mounting & connection

Flush mounting, back connection, clamp fixing. Direct mounting bottom connection.

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 The bidder shall strictly follow the Quality Plan (s) included in Volume-IIB.

4.3 The following tests shall be conducted as a minimum requirement:

a) Routine Tests

i) Accuracy Test.
ii) Overload test.
iii) Hysteresis
iv) Contact Rating (for switch)
v) Repeatability (for switch)
vi) HV / IR (for switch)

b) Type tests

i) Blow out disc
ii) Weatherproof, water tight and Dust tight tests.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3 (b), "Type Test Certificates" as per Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House/ Laboratory approved by BHEL.

4.5 The Standard QP is included in this specification to enable bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed QP, taking care of customer requirements mentioned in Sec-C and submit QP for final approval by BHEL / Customer.

5.0 SPARES AND CONSUMABLES

5.1 Recommended Spares

The bidder shall furnish a list of Recommended Spares along with the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with 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 :

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogues with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and ~~despatch~~dispatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/installation drawings.

ii) Data sheet-C, completely filled-up along with all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final / As-built drawings / ~~RTFs~~ CDs in required number of copies shall be submitted.

6.3.0 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-~~plate shall~~plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of ~~despatch~~dispatch, storage and erection against impact, abrasion, corrosion, 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.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

Data sheet A & B and C for Pressure / Differential Pressure Gauge
(Data sheet no. PE-DC-999-145-I026-1)

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH**	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 1 OF 1	

TAG No. ……. Qty..... Data Sheet No.: **PES-145-31-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE OF ELEMENT	☐ DIAPHRAGM ☐ BELLOW (for low range) ☐ PISTON ☐ BOURDON (for high range)	
	MATERIAL	ELEMENT: ☐ AISI 316 SS ☐ Ph. Br. CASING : DIE CAST AL	
	ENCLOSURE	☐ INDOOR MOUNTED IP-55 ☐ OUTDOOR MOUNTED IP-65 ☐ IP-67 ☐ FUEL GAS HAZARDOUS APPL. EXPL. PROOF	
	SWITCH TYPE	☐ MICRO ☐ ENCLOSURE HERMETICALLY SEALED	
	SWITCH CONTACT	TWO NOS. SPDT	
	SWITCH RATING	☐ 5A 230V AC ☐ 0.25A 220V DC	
	SETTING & DEAD BAND	ADJUSTABLE	
	MOUNTING	☐ DIRECT ☐ PANEL OR RACK	
	OVER RANGE PROTECTION	115% ABOVE 150 Kg/Cm2 125% BELOW 150 Kg/Cm2	
PERFORMANCE	ACCURACY (SCALE)	± 1%	
	REPEATABILITY	± 0.5%	
CONNECTION	PRESSURE CONNECTION	¼" NPT (F) AT BOTTOM	
	ELECTRICAL	WITH GLAND TO SUIT CABLE OF MAXIMUM O.D. 17.5 MM.	
INSTALLATION ACCESSORIES	AS PER ENCLOSED DRAWING		

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 1

TAG No. ……. Qty..... Data Sheet No.: **PES-145-31-DS2-0**

Data Sheet C

DATA SHEET-C FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER	
	MODEL NUMBER	
TECHNICAL	TYPE OF ELEMENT	
	MATERIAL	
	ENCLOSURE	
	SWITCH TYPE	
	SWITCH CONTACT	
	SWITCH RATING	
	SETTING & DEAD BAND	
	MOUNTING	
	OVER RANGE PROTECTION	
PERFORMANCE	ACCURACY (SCALE)	
	REPEATABILITY	
CONNECTION	PROCESS	
	ELECTRICAL	
INSTALLATION ACCESSORIES	AS PER DRG. ENCLOSED.	

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH	SPECIFICATION NO.: PES – 145 – 031	
		VOLUME II B	
		SECTION D	
		REV. NO. 03	DATE : 16-05-2007
		SHEET 1	OF 3

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 of Pressure/Differential Pressure Switch for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

2.3 As a minimum requirement, the following standards shall be complied with :
Enclosure : ISA:RP:8.1

3.0 TECHNICAL REQUIREMENTS

3.1 General

The pressure switches shall be suitable for an ambient temperature of 0-55°C and Relative Humidity of 0-95%.

3.2 Housing

Weather proof and dust tight housing made of Die-cast aluminium alloy. The external surface of the housing shall have a finish of light grey epoxy enamel.

3.3 Pressure Element

The pressure element shall be seamless hydraulically formed DIAPHRAGM/BELLOWS in Stainless steel/Phosphor Bronze for low pressure applications and stainless steel bourdon/piston for high pressure applications.

3.4 Switching differential

The switching differential shall be adjustable. The set point adjuster for the differential setting shall be inside the housing and shall be adjustable against a calibrated scale.

3.5 Pressure Connection

The pressure connection shall be at bottom. Size shall be 1/4" NPT (F) and material shall be stainless steel.

3.6 Electrical entry

Cable gland with Neoprene gourmet to suit PVC cable up to 17.5mm outside diameter.

3.7 Accuracy

$\pm$1% of scale range.

3.8 Micro-switch data

Micro-switch for AC/DC, single pole double throw, contacts having ratings 5 Amps at 230V AC, 0.25 Amps at 220V DC.

3.9 Over pressure range

The pressure switch shall function without any deterioration in the accuracy as specified in clause 3.8 when subjected to an over pressure of 25% above the ranges.

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 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following test shall be conducted as a minimum requirement.

a) Routine Tests

i) Repeatability.

ii) Over load.

iii) Contact Rating.

b) Type Tests

i) Enclosure Class (Weatherproof, water tight & dust tight test).

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3 (b), "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House /Laboratory approved by BHEL.

4.5 The Standard QP is included in this specification to enable bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed QP, taking care of customer requirements mentioned in Sec-C and submit QP for final approval by BHEL / Customer.

5.0 SPARES AND CONSUMABLES

5.1 Recommended Spares

The bidder shall furnish a list of Recommended Spares alongwith 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.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 alongwith the bid :

6.1.1 Data sheet-B, completely filled-up alongwith all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogs wtih detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and dispatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/Installation drawings.
ii) Data sheet-C, completely filled-up alongwith all the enclosures.
iii) Quality Plan of vendor/sub-vendor.
iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final / As-built drawings / CD in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, 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.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Pressure/Differential Pressure Switch : Data sheet no. PES-145-31-DS1-0
- Data sheet C Pressure/Differential Pressure Switch : Data sheet no. PES-145-31-DS2-0

	SPECIFICATION FOR LEVEL TRANSMITTER (DISPLACEMENT TYPE)	SPECIFICATION NO.: PES – 145 - 08	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 19.12.95
		SHEET 1 OF 4	

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 of Level Transmitter (Displacement Type) for use in Vacuum and low pressure services in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

3.0 TECHNICAL REQUIREMENTS

3.1 General

The level transmitter shall be suitable for an ambient temperature 0-55°C & RH 0-95% and shall be equipped with all accessories required for specific service condition. Transmitters shall produce electric current output of 4-20mA proportional to the changes in liquid level.

3.2 Principle of operation

The operation of the Level Transmitter depends upon the movement of displacer due to level variation inside the vessel. The movement is converted into rotary movement by torque element and fed to a Rotary Variable Differential Transformer (RVDT) to obtain 4-20mA DC signal.

3.3 Output Signal

4-20mA DC two wire system.

3.4 Material

Cage (Displacer Chamber)	:	Forged carbon steel/Stainless Steel.
Displacer	:	SS 304/316 SS
Linkage & Torque Tube	:	316 SS

3.5 Rating of Body, Cage & End Connection:

Rating of Body, Cage & End Connection shall be as per Data Sheet.

3.6 Enclosure (Case & Cover)

The transmitter enclosure shall be as per IP-65 unless otherwise specified.

3.7 Zero and Span Adjustment

The transmitter zero and span shall be continuously adjustable through simple devices. The span and zero adjustments shall be independent and non interactive. Each transmitter shall be factory callibrated to the range specified in instrument data sheet.

3.8 Connection

The transmitter shall be supplied with flanged connection. Mating flanges with gasket & nut bolts shall be supplied.

3.9 Mounting

The level transmitter cage shall be mounted on the vessel through suitable flanged connection at top, bottom or side as specified in the Data Sheet.

3.10 Power Supply

The transmitter shall be suitable for 24V DC.

3.11 Signal Grounding

The design of transmitter electronic shall be such that grounding of any of the output wires will not damage the transmitter.

3.12 Cable Entry

Cable gland complete with neoprene gromet suitable for PVC cables with maximum diameter of 11.5mm shall be provided for cable entry. The actual size of the cable shall be indicated during contract stage.

3.13 Terminal Box

A Terminal Box shall be provided for the signal/supply and test terminals.

3.14 Performance Data

3.14.1	Linearity	:	± 1.0% of span or better.
3.14.2	Hysterisis	:	± 1.0% of span or better.
3.14.3	Repeatability	:	<0.5% of span or better.
3.14.4	Accuracy	:	± 1.0% of span or better.
3.14.5	Supply voltage variation effect	:	± 0.05% of span or better per volt.
3.14.6	Sp. gravity range	:	0.2 - 1.4
3.14.7	Action	:	Direct or reverse (As per Data Sheet)
3.14.8	Ambient temp. limits	:	80°C

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 The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following test shall be conducted as a minimum requirement.

a) Calibration test to confirm compliance with clauses 3.14.1 to 3.14.10 of this specification.

b) IP 65 Enclosure (Type Test).

c) Over range pressure test to confirm compliance with clause 3.5 of this specification.

d) Hydraulic Test for the Cage & Transmitter Body with Displacer as per ANSI B16.34.1988.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the items, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House/Laboratory approved by BHEL.

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

As part of the main equipment supply, the bidder shall supply all commissioning spares and consumables required during Start-up, commissioning and Trial-runs of the plant on as required basis.

5.2 Mandatory Spares

The bidder shall offer along with main offer 5% (Maximum 2 Nos.) transmitters of all types, range and model no. (for the measurement of Pressure, Diff. Pressure, Flow level etc.) . 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 along with the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with 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 :

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/Installation drawings.

ii) Data sheet-C, completely filled-up alongwith all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final/As-built drawings/RTFs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, 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.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Level Transmitter : Data sheet no. PES-145-08-DS1-0
- Data sheet C for Level Transmitter : Data sheet no. PES-145-08-DS2-0

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 of Pressure/Differential Pressure Transmitter for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

3.0 TECHNICAL REQUIREMENTS

3.1 General

The transmitter shall be suitable for ambient temperature 0-55°C. and Relative humidity 0-95%. Transmitters shall be equiped with all accessories required for specific service conditions. Syphons shall be provided for steam service applications. Pulsation dampeners shall be provided for unstable process media such as discharge of pump. Diaphragm seals shall be used where the sensing element comes in contact with corrosive or dirty process fluid. The transmitter measurement for viscous process fluid shall be filled system type with separate Capillary and other required accessories. The transmitters shall be provided with suitable drain & vent points.

3.2 Principle of operation

The electronic differential pressure & pressure transmitters shall be as specified in the data sheet.

3.3 Output Signal

4-20mA DC two wire system unless otherwise specified.

3.4 Material

- Body : Forged Carbon Steel.
- Diaphragm : 316 SS
- Capsule : 316 SS
- Bellow : 316 SS
- Bourdon : 316 SS
- Measurement seal element : Teflon

3.5 Body Rating

Transmitter Body and measuring element (other than electronic housing shall be atleast 1.5 times the maximum process fluid pressure.

3.6 Zero and Span Adjustment

The transmitter zero and span shall be continuously adjustable through a simple field adjustment. The span and zero adjustment shall not interfere with each other. The ratio of maximum span to minimum span shall be atleast five (5) Each transmitter shall be factory callibrated to the range specified in instrument data sheet.

3.7 Zero Elevation or Supression

Zero Elevation or Supression for level measurement shall be provided as standard feature. The continuously adjustable zero elevation device wherever required by the operating range of the transmitter (range specified in data sheet) shall be supplied.

3.8 Working temperature of the cell body shall not be less than 100°C.

3.9 Process Connection

The transmitter shall be supplied fitted with 3/5 way valve manifolds having 1/2" NPT (F) connection for Process.

3.10 Mounting

The transmitter shall be suitable both for wall and pipe/stand mounting. Necessary mounting brackets, clamps, bolts and nuts shall be supplied along with transmitter as standard feature. The actual mounting requirement i.e. wall or pipe stand is indicated in the instrument data sheet.

3.11 Power Supply

The transmitter supply shall be 12 to 48V DC (4-20mA/0-20mA output).

3.12 Load Limit

The load limit shall be 500 Ohms at 24V DC and 1500 Ohms at 48V DC.

3.13 Reverse Polarity Protection

For reverse polarity connection of the power supply, there shall cause no damage to transmitter. Reverse current should be limited to 1 mA.

3.14 Signal Grounding

The design of transmitter electronic shall be such that either of the output wires may be grounded, causing no damage to transmitter.

3.15 Cable Entry

Cable gland complete with neoprene gromet suitable for PVC cables with maximum diameter of 17.5mm shall be provided for cable entry. The actual size of the cable shall be indicated during contract stage. Any other satisfactory arrangement for cable entry with proper sealing at entry shall also be acceptable.

3.16 Enclosure

The transmitter enclosure shall be as per NEMA-4 unless otherwise specified. Explosion proof enclosures shall be as per NEMA-7.

3.17 Terminal Box

A terminal unit accessible without exposing the transmitter mechanism shall be provided for signal/supply cable terminations and for test terminals.

3.18 Performance Data

3.18.1	Linearity	:	± 0.1% of span or better.
3.18.2	Hysterisis	:	± 0.1% of span or better.
3.18.3	Dead Band	:	± 0.1% of span or better.
3.18.4	Repeatability	:	± 0.1% of span or better.
3.18.5	Accuracy	:	± 0.5% of span or better.
3.18.6	Sensitivity	:	± 0.05% of span or better.
3.18.7	Stability	:	± 0.25% of span or better for six months.
3.18.8	Supply voltage variation effect	:	± 0.05% of span or better per volt.
3.18.9	Load resistance	:	± 0.0005% of span or better variation per ohm.
3.18.10	Vibration effect	:	Mechanical vibration in 3 mutually perpendicular planes with 0.07 mm amplitude from 10 to 60 Hz and 10m/sec2 acceleration from 60 to 150 Hz. shifts at 50% input shall be <0.01% of span.
3.18.11	Temperature variation effect	:	± 0.5% of span or better per deg.C.
3.18.12	EMI effect	:	DC magnetic field effect at 0% and 100% input upto 50 gauses. - On Zero : Less than 0.1%. - On Span : Less than 0.1%.
3.18.13	RFI effect	:	Radio frequency interference (upto 500 MHz), with field strength of 5 V/M shall not deviate the accuracy by more than 0.1%.

3.18.14 Damping : Damping shall be step or continuously adjustable so that time constant varies from 0-3s or 0-6s.

3.18.15 Static pressure : Zero shift < 0.5% of span for effect pressure change up to static pressure limit.

3.19 Accessories

3.19.1 Valve Manifolds

All differential pressure and pressure transmitters shall be supplied with 5 way and 3 way valve manifold respectively.

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 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following tests shall be conducted as a minimum requirement:

a) Calibration test to confirm compliance with clauses 3.18.1 to 3.18.5 of this specification.

b) Enclosure as specified in data sheet (Type Test).

c) Over range pressure test to confirm compliance with clause 3.5 of this specification.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the items, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House/Laboratory approved by BHEL.

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

As part of the main equipment supply, the bidder shall supply all commissioning spares and consumables required during Start-up, commissioning and Trial-runs of the plant on as required basis.

5.2 Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified in Volume IIB Section C of 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 alongwith 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 seperate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

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

6.1.1 Data sheet-B, completely filled-up alongwith all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogues with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and despatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/installation drawings.

ii) Data sheet-C, completely filled-up along with all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final/As-built drawings/RTFs in required number of copies shall be submitted.

6.3.0 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, 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.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

Data sheet A&B and C for Pressure/Differential Pressure Transmitter	:	Data sheet no. PES-145-01-DS1-0
Data sheet C for Pressure/Differential Pressure Transmitter	:	Data sheet no. PES-145-01-DS2-0

	SPECIFICATION FOR TEMPERATURE ELEMENT (WITH THERMOWELL)	SPECIFICATION NO.: PES – 145 - 03	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 27.07.94
		SHEET 1	OF 10

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 of Temperature Element (with Thermowell) for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

3.0 TECHNICAL REQUIREMENTS

3.1 General

The temperature sensor elements shall be duplex type, either thermocouple (T/C) or resistance temperature detector (RTD). Unless otherwise specified in the data sheet, the type of sensors for different applications shall be as follows:

i) Chromel - Alumel T/C medium temp. range (250°C to 600°C)

ii) Platinum-Rhodium Platinum High temp. range (600°C and above). Type S/R/B.

iii) Platinum RTD Low temperature & high accuracy (-50°C to 250°C).

3.2 Process Parameters

Process parameters such as line size, pressure, temperature, fluid medium are given in the instrument data sheet.

3.3 Thermocouple Wire Size

The thermocouple wire size for a given temperature application shall be as per table – 3.1A of ASME PTC 19.3 – 1974.

3.4 Sensor Grounding

Thermocouple junction shall be generally ungrounded type unless specified otherwise in the data sheet for the thermocouple.

3.5 Sensor Protective Sheath & Wire Insulation

The sensor protective sheath shall be 8mm OD 316 SS seamless tube using compacted magnesium oxide packing/porcelain for insulation.

3.6 Sensor Characteristics

Thermocouple calibration characteristics i.e. temperature vs. milli volt or resistance shall be as per the applicable Indian Standards (IS-2054 for thermocouple 'K' type, IS-2055 for Pt.Rd.Pt.), RTD type of sensor calibration i.e. temperature vs. resistance shall be as per the applicable Indian Standard (IS-2848).

3.7 Sensor Accuracy Limits

T/C sensor limiting accuracy shall be as per table 3.2A of ASME PTC 19.3 – 1974. RTD sensor accuracy shall be as per table 9.1 of ASME PTC – 19.3 – 74.

3.8 Insulation Resistance

Insulation resistance of RTD leads w.r.t. body shall be more than 5 mega ohms at 100V DC.

3.9 End Connection

The sensor assemblies shall have screwed M33 x 2 end connection. Specific design requirements of pressure, temperature and end connection type for a given application are indicated in the instrument data sheet.

3.10 Terminal Head

Terminal head cover shall be screwed type design having gasket with small flexible chain attached between fixed portion and head cover.

3.10.1 Terminal Head Enclosure

The terminal head enclosure shall be dust, weather proof and water proof as per NEMA-4 classification unless specified otherwise.

3.10.2 Terminals

The terminal head shall have provision of screwed terminal of 1.5 mm^2 size for external connection. The terminals shall be suitably marked '+ve' & '-ve' for thermocouple and 'Lo', 'Hi' and 'C' for three wire RTD.

3.11 Cable Entry

Cable gland complete with neoprene gromet suitable for PVC cable with maximum diameter of 17.5mm shall be provided for cable entry. The actual size of cable shall be indicated during the contract stage. Separate cable entry and cable glands shall be provided for both the elements.

3.12 Thermowell

Temperature element shall be supplied along with the thermowell. The thermowell shall be of tungstion carbide for mill air temperature and for rest of the applications of AISI 316SS forged bar stock shall be designed to suit the process conditions. For detail of the thermowell, see enclosed drawing.

3.12.1 Thermowell Extension Length

Temperature sensor assemblies shall have extension length as specified in tables so that the terminal head clears the pipe line insulation. The extra extension length requirement if any, special applications shall be indicated in the data sheet.

3.12.2 Material of Thermowell Assemblies

Material of thermowell assemblies as indicated in clause 3.12 unless specified otherwise. The thermowell shall be machined out of solid bar stock. The surface of thermowell over working length portion shall be polished. Thermowell shall be with taper profile. For details of the thermowell see Fig. (1) & Fig. (2).

3.12.3 Internal Construction

Sensor assemblies shall preferably be metal sheathed with spring load on to the thermowell tip for better response. The sheathed sensor assembly shall be replaceable (in-situ) type without removal of thermowell.

3.12.4 Compensating cable should be used for connecting elements to secondary Instruments/Device unless there is specific requirement for cold junction compensation. Field mounted cold junction compensation box as per NEMA-4 shall be provided for all thermocouples. The CJC box shall have automatic temperature control at reference junction temperature of 60 Deg. C. Each CJC box shall be provided with duplex RTD for remote monitoring.

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 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with all the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following routine tests shall be conducted as a minimum requirement :-

4.3.1 Physical dimension of the sensor assemblies as per approved drawing.

4.3.2 Electrical characteristic of sensor such as continuity of the thermocouple wires, and insulation resistance of the RTD leads w.r.t. body.

4.3.3 Temperature vs. Resistance / milli volt for the sensor assemblies shall be tested with reference to standard resistance thermometer by comparison method. This test may be carried out once for the T/C or RTD sensor wires for each batch production.

4.3.4 Each type of high pressure thermowell assembly with thread end connection shall be tested against hydrostatic test pressure of one & a half times the maximum working pressure for any leakage. However dimensional checks and thread conformity with gauges shall be checked for each sensor assembly.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the items, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House / Laboratory approved by BHEL.

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

Nil.

5.2 Mandatory Spares

Nil.

5.3 Recommended Spares

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

5.4 Special Tools & Tackles

Nil.

6.0 DRAWINGS AND DOCUMENTS

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

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.1.2 Quality Plan of bidder.

6.1.3 Catalogs with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for manufacture testing and despatch.

6.1.5 Schedule for manufacturing, testing and dispatch (Enclosed in Vol.-II B).

6.2 The successful bidder shall furnish the following documents in required number of copies to BHEL during the contract stage :

6.2.1 For approval

i) Dimensional drawings.

ii) Installation drawings with overall dimensions of the completed equipment and clearances for operation and maintenance.

iii) Data sheet-C, completely filled-up along with all the enclosures.

iv) Quality Plan of vendor/sub-vendor.

v) Test Certificates.

6.2.2 For information

i) Storage instructions.

ii) Commissioning instructions.

6.2.3 Final/As-built Drawings

Final/As-built drawings/RTFs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted.

7.0 MARKING AND PACKING

7.1 Marking

A metal name-plate should be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment / materials shall be suitably packed and protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, 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 transmit and storage is open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Temperature Element (With Thermowell) : Data sheet no. PES-145-03-DS1-0

- Data sheet C for Temperature Element (With Thermowell) : Data sheet no. PES-145-03-DS2-0

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 of Level Switch (Float type/displacer type) for use in Utility/Captive Power Station/Combined Cycle Station.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

3.0 TECHNICAL REQUIREMENTS

3.1 General

The switches shall be magnetically operated, glandless type, suitable for tropical climate for operation at 0-55°C and Relative Humidity 0-95%. The switch shall be suitable for top mounting or side mounting with external chamber.

3.2 Housing

The switch housing shall be of die cast Aluminium/SS-304, weather proof, drain tight, water tight and dust tight as per NEMA 4.

3.3 Float Assembly/Displacer

The float assembly/displacer shall be made of stainless steel to AISI:316. Wire rope, spring housing, sleeve pipe shall also be of AISI:316.

3.4 External Chamber

The material for external chamber for side mounted level switches shall be as per data sheet and shall be of suitable thickness.

A drain plug shall be provided in the external chamber to facilitate testing.

The external chamber and the float assembly shall be arranged from the Level Switch supplier and not fabricated at site.

3.5 Mounting

The switch shall be suitable for direct mounting on the vessel at top or side mounted on an external chamber connected to the vessel.

3.6 Switching Data

The switch shall be single pole double throw (SPDT) or Double Pole Double Throw (DPDT) as specified in the data sheet.

The switch contacts shall be suitable for current rating 5A at 230V AC and 0.25A at 220V DC.

3.7 Differential

The differential between make and break shall be 12 ±2 mm for side mounted and 35 ±3 mm for top mounted. Other adjustable range to suit the specific requirement shall also be acceptable.

3.8 Specific gravity of the fluid

Specific gravity of the fluid shall be 0.7 to 1.2.

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 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following test shall be conducted as a minimum requirement.

a) Routine Tests

i) Repeatability Test.

ii) Contact Rating Test.

b) Type Tests

Weatherproof, water tight & dust tight test.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3 (b), "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House /Laboratory approved by BHEL.

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares

The bidder shall supply all commissioning spares along with the equipment.

5.2 Recommended Spares

The bidder shall furnish a list of Recommended Spares along with the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with 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:

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogs with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and despatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage:

6.2.1 For approval

i) Dimensional/Installation drawings.
ii) Data sheet-C, completely filled-up along with all the enclosures
iii) Quality Plan of vendor/sub-vendor.
iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final/As-built drawings/RTFs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, 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.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Level Switch (Float/Displacer type) : Data sheet no. PES-145-33-DS1-0

- Data sheet C for Level Switch (Float/Displacer type) : Data sheet no. PES-145-33-DS2-0

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 of Level Transmitter (Capacitance Type) for use in the tanks/chambers for oil applications.

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 The Design and Materials used for the components shall also comply with the relevant National and International standards.

2.3 This specification is based on BHEL experience.

3.0 TECHNICAL REQUIREMENTS

The transmitter shall be complete with sensor, preamplifier, amplifier, plug receptacle connector, connecting cables etc. as per detail below.

The basic measurement function shall be based on variable capacitance principle.

3.1 SENSORS:

The sensor shall be based on variable capacitance principle consisting of rod probe with ground tube of SS-316 as per dimensions given in Fig. 1

The probe and the ground tube form a capacitor whose capacitance changes on the change in level due to difference in the dielectric constant of the liquid media and that of air.

3.2 PREAMPLIFIER

The preamplifier shall convert the change in the capacitance to a suitable electrical signal for transmission to an amplifier which is located away to a safer distance.

The preamplifier shall be mounted on the sensor head as per mounting and connection arrangement shown in fig 2. The protection class shall be IP65 (minimum) as per IS: 13947 (part 1) and ambient temperature should be 0 degree C to +60 degree C

3.3 AMPLIFIER

The output signal from the preamplifier shall be amplified and processed for the desired output. The amplifier shall have provision of adjustment and calibration. The measuring range shall be adjustable so that output can be calibrated for any range between 0-50% to 0-100% of the span L1 (Ref fig 1). Provision shall be made to shift the range above or below so as to cover the entire length of the probe.

The other requirements are given below:

3.3.1 Measuring Range (Ref fig 1) : Equal to the length of the probe

3.3.2 Output :4-20 mill ampere Galvanically isolated DC for Upto 500 ohm for any range as specified at Cl 3.3

3.3.3	Power Supply	: 24 VDC or 240VAC, 50 Hz
3.3.4	Accuracy	: +/-2.0% of full span or better
3.3.5	Protection Class	: IP65 (minimum) OR better
3.3.6	Housing	: Die Cast Aluminum stoving enamel painted, Weather proof, projection mounting
3.3.7	Ambient Temperature	: 0 degree C to + 60 degree C

3.3.8 Amplifier can be separately mounted or head mounted. For head mounted type refer fig 4

4.0 ELECTRICAL CONNECTIONS

All cables from sensor to preamplifier and/or to amplifier shall be in bidder's scope.

All connections will be plug in connections.

5.0 SURFACE PROTECTION OF AMPLIFIER AND PROBE HEAD

The external surface shall be so treated that it can withstand a sustained environment of phosphoric fume at 60 degree C and/or medium turbine oil at 60 degree C

6.0 MARKING AND PACKING

6.1 Marking

Following details shall be marked on the packing case.

a) Manufacturer's name or trade mark
b) BHEL Order No.

Each instrument shall have a stainless steel name plate marked on it the following

a) Tag No.
b) Technical Specifications
c) Manufacturer's name or trade mark
d) Type of the instrument
e) Model number of the manufacturer
f) Range of measurement
g) Accuracy

A name-plate shall be permanently fixed on each equipment giving its Tag Number and technical

specifications.

6.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, 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.

Each instrument with dehydrating agent shall be sealed individually in polythene sheets and packed jn a thermocole box. Such Boxes shall be packed in a carton or case with adequate cushioning material to withstand normal transit risk.

7.0 TESTING AND INSPECTION

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

7.2 The following test shall be conducted by supplier as a minimum requirement on each piece of sensor and indicator/amplifier.

7.2.1 ROUTINE TESTS

a) Visual Inspection and dimensional check

b) Functional Test for adjustable range

c) Accuracy Tests

d) Burn in test for amplifier electronics

7.2.2 Type Tests

Type test reports (not more than 5 years old) shall be furnished for the following additional tests on amplifier electronics as per IEC 60068

a) Damp Heat Test
b) Temperature Cycle Test
c) Dry Heat Test
d) Vibration Test
e) Protection Class

Inspection will be conducted by BHEL and/or their authorized representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the items, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorized representatives or in independent Test House/Laboratory approved by BHEL at their cost.

8.0 TEST CERTIFICATES

Each piece of sensor/preamplifier/amplifier shall accompany with three copies of test certificates with:

a) Name of the instrument
b) Name of the manufacturer
c) Serial No and model no. of the instrument
d) Date of testing

Results of the test detailed in clause 6.0

9.0 GUARANTEE CERTIFICATE

Each piece of sensor/preamplifier/amplifier shall accompany a guarantee certificate for trouble free performance for 24 months from the date of shipment or 12 months from the date of commissioning whichever is earlier.

10.0 QUALITY PLAN

Detail quality plan for the tests and checks to be carried out during material induction, manufacturing and at final stage shall be submitted in BHEL's format along with in-house standard procedures/normal for BHEL's approval.

11.0 SPARES AND CONSUMABLES

11.1 Commissioning Spares and consumables

As part of the main equipment supply, the bidder shall supply all commissioning spares and consumables required during Start-up, commissioning and Trial-runs of the plant on as required basis.

11.2 Mandatory Spares:

The Mandatory Spares offered shall be of the same make and type as the main equipment.

11.3 Recommended Spares

The bidder shall furnish a list of Recommended Spares along with the normal service expectancy period and frequency of replacement; quantities recommended for 5 years operation along with unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

12.0 DRAWINGS AND DOCUMENTS

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

12.1.1 Technical literatures including drawings and Data sheet-B, completely filled-up along with all enclosures.

12.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage:

12.2.1 for approval

i) Dimensional/Installation drawings.

ii) Data sheet-C, completely filled-up along with all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

12.2.2 Final/As-built Drawings

Final/As-built drawings/RTFs in required number of copies shall be submitted.

12.3 Operation & Maintenance Manuals

O&M Manuals in Hard Copy and soft form (1CDROM) in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

13.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms:

- Data sheet A for Level Transmitter(capacitance type)
- Data sheet C for Level Transmitter(capacitance type)

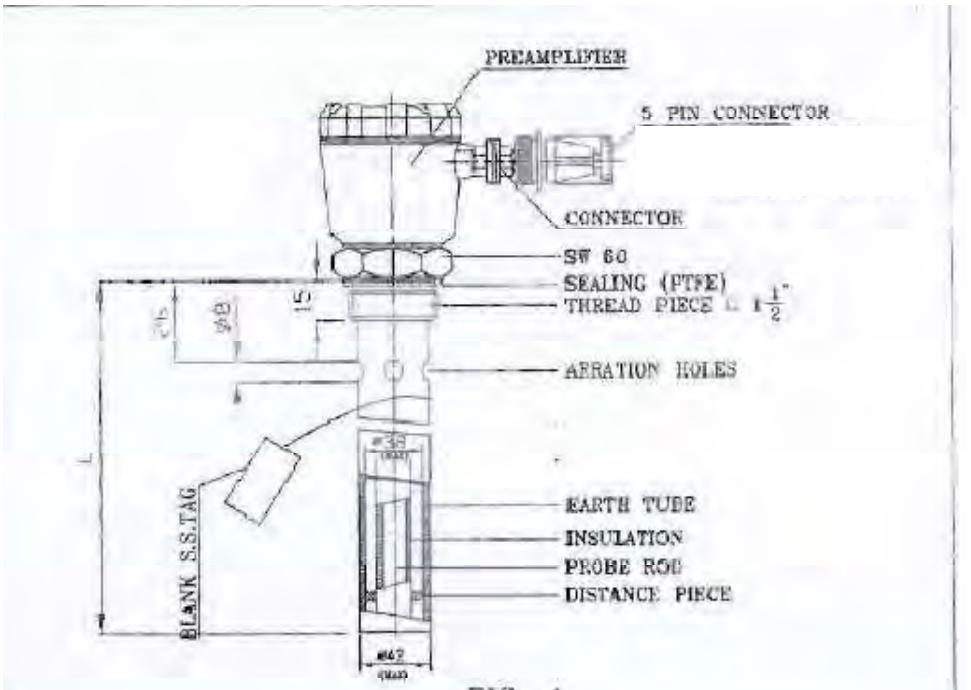


FIG. 1

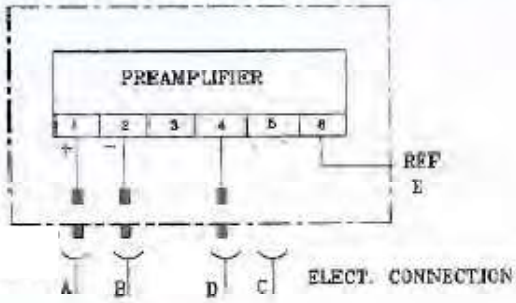


FIG 2

Pls Note: Shape of the instrument shown is typical .Actual shape may vary with make.

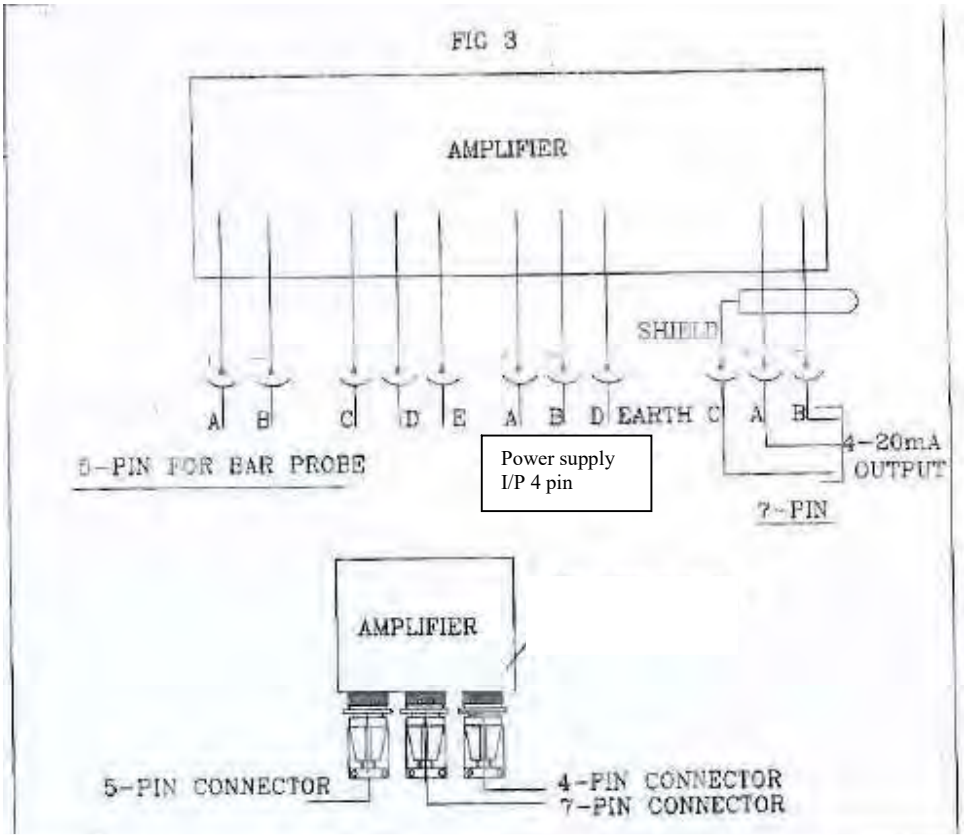
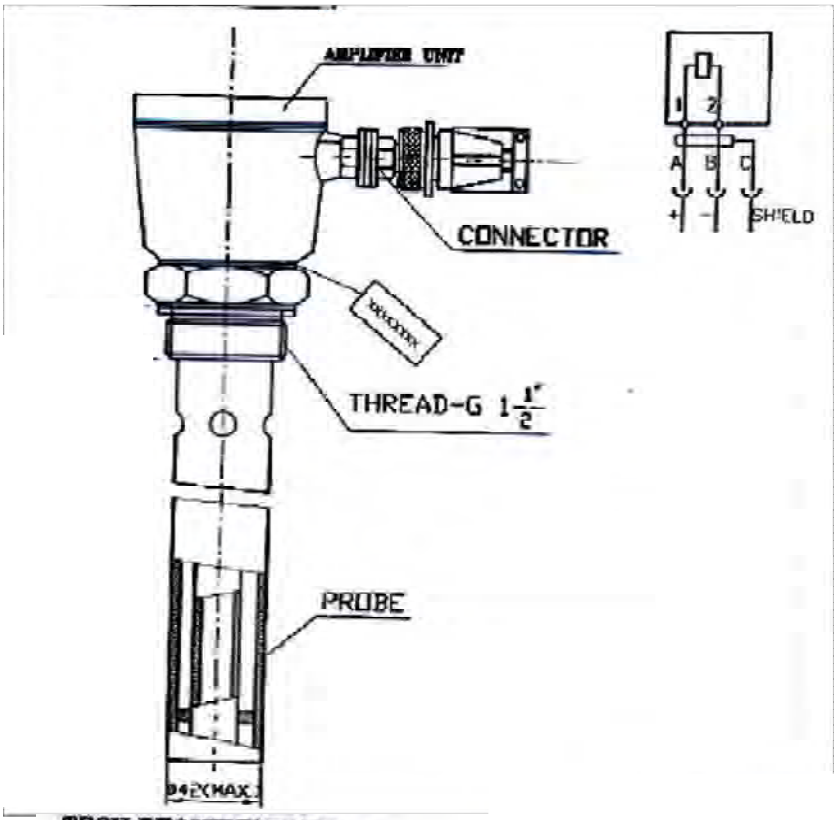


FIG 3
AMPLIFIER
SHIELD
A B C D E A B D EARTH C A B
4-20mA OUTPUT
5-PIN FOR BAR PROBE
Power supply I/P 4 pin
7-PIN
AMPLIFIER
5-PIN CONNECTOR
4-PIN CONNECTOR
7-PIN CONNECTOR

FIGURE 4(For Level Tx. With Integral amplifier)



TECH.REQUIREMENTS:-

1. VARIABLE CAPACITANCE TYPE LEVEL TRANSMITTER WITH AMPLIFIER INTEGRAL WITH PROBE HEAD.
2. FOR OTHER DETAILS REF. TECH. SPEC.
3. CONSTRUCTION FEATURES, TEST, TEST CERTIFICATES, GUARANTEE, DOCUMENTS, PACKING AND MARKING SHALL BE AS GIVEN IN STANDARD
4. DRAWING, TEST CERTIFICATES & DATA SHEET TO BE SUBMITTED FOR APPROVAL ALONG WITH THE OFFER.
5. PLUG CONNECTOR 3 PIN FOR POWER SUPPLY AND 4 TO 20 m. a. OUT PUT.
6. BOTH, MALE & FEMALE CONNECTORS SHOULD BE DULY FITTED WITH AMPLIFIER & DULY ASSEMBLED TOGETHER. THIS IS TO BE ENSURED BEFORE DESPATCH.
7. SHAPE OF THE INSTRUMENT SHOWN IS TYPICAL. ACTUAL SHAPE MAY VARY WITH MAKE.

Tag No.

DATA SHEET – A

DATA SHEET – A
(TO BE FILLED BY PURCHASER)

GENERAL	MAKE MODEL NO.	BIDDER TO SPECIFY BIDDER TO SPECIFY
SERVICE	MEDIUM UPPER FLUID TYPE PRESSURE OPERATING / DESIGN. TEMP. OPERATING / DESIGN. AMBIENT TEMPERATURE	LIQUID(OIL) OIL AS PER PROJECT DATA AS PER PROJECT DATA 0 – 60 C
PROCESS CONNECTION	THREADED	1 ½" BSP(M)
PROBE HEAD	ENCLOSURE CLASS CABLE ENTRY SIZE/ NO. HOUSING MATERIAL	IP-65 PLUG IN CABLE 5 PIN (INT) DIE CAST ALUMINIUM
	POWER SUPPLY	240VAC , 50 Hz OR 24VDC

	PRPED BY	CHKD BY	APPD BY
NAME			
SIGN			
DATE			

Tag No.

DATA SHEET – A

DATA SHEET – A
(TO BE FILLED BY PURCHASER)

ELECTRODE	ELECTRODE TYPE	ROD
	SENSING ELECTRODE MATERIAL	SS316
	SHEATING COATING	PTFE
	OUTER PIPE SIZE	AS REQUIRED
	OUTER PIPE MATERIAL	SS316
	LENGTH	AS PER PROJECT DATA
	OUTPUT	4 – 20 mA galvanically isolated DC for upto 500ohm
	ACCURACY	+/- 2.0% of full span or better
	ALL CONNECTIONS	AS PER SKETCHES ENCLOSEED

	PRPED BY	CHKD BY	APPD BY
NAME			
SIGN			
DATE			

NOTE: Amplifier can be head mounted or separately mounted. In case of separately mounted amplifier bidder to supply necessary erection hardware as well as necessary cable from sensor/preamplifier to separately mounted amplifier (approx 10-15 meters)

Tag No.

DATA SHEET – C

DESCRIPTION		DATA SHEET - C (TO BE FILLED BY THE VENDOR AFTER AWARD OF CONTRACT)
GENERAL	MAKE MODEL NO.	
SERVICE	MEDIUM UPPER FLUID TYPE PRESSURE OPERATING / DESIGN. TEMP. OPERATING / DESIGN. AMBIENT TEMPERATURE	
PROCESS CONNECTION	THREADED	
PROBE HEAD	ENCLOSURE CLASS CABLE ENTRY SIZE/ NO. HOUSING MATERIAL	
	POWER SUPPLY	

	PRPED BY	CHKD BY	APPD BY
NAME			
SIGN			
DATE			

Tag No.

DATA SHEET – C

DESCRIPTION		DATA SHEET - C (TO BE FILLED BY THE VENDOR AFTER AWARD OF CONTRACT)
ELECTRODE	ELECTRODE TYPE SENSING ELECTRODE MATERIAL SHEATING COATING OUTER PIPE SIZE OUTER PIPE MATERIAL LENGTH	
	OUTPUT ACUURACY	
	ALL CONNECTIONS	

	PRPED BY	CHKD BY	APPD BY
NAME			
SIGN			
DATE			

NOTE: Amplifier can be head mounted or separately mounted. In case of separately mounted amplifier bidder to supply necessary erection hardware as well as necessary cable from sensor/preamplifier to separately mounted amplifier (approx 10-15 meters)

PEM :: C&I	STANDARD QUALITY PLAN FOR LEVEL TRANSMITTER (CAPACITANCE TYPE)	QP NO.-	PE-QP-999-145-I011
		VOLUME : IIB	SECTION : D
		REV : 00	DATE : 15.09.10

SL NO.	TEST/CHECKS	QUANTUM OF CHECK	REF DOC ACCEPTANCE NORMS	AGENCY			REMARKS
				P	W	V	
1	CHECK FOR TYPE MAKE MODEL NO.	SEE NOTE -1 BELOW	APPROVED SPEC./ DATA SHEET	3/2	2/1	1	ROUTINE TEST
2	FUNCTIONAL TEST	DO	DO	3/2	2/1	1	ROUTINE TEST
3	ACCURACY TEST	DO	DO	3/2	2/1	1	ROUTINE TEST
4	BURN IN TEST	DO	DO	3/2	___	1	ROUTINE TEST
5	DAMP HEAT TEST	DO	DO	3/2	___	1	TYPE TEST
6	TEMP. CYCLE TEST	DO	DO	3/2	___	1	TYPE TEST
7	DRY HEAT TEST	DO	DO	3/2	___	1	TYPE TEST
8	VIBRATION TEST	DO	DO	3/2	___	1	TYPE TEST
9	PROTECTION TEST	DO	DO	3/2	___	1	TYPE TEST

LEGEND:	ALL RECORDS SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR ON QA DOCUMENTATION
	1:BHEL 2:VENDOR 3:SUBVENDOR
	P:PERFORM W:WITNESS V:VERIFICATION

NOTE :	1) QUANTUM OF CHECK SHALL BE AS FOLLOWS :	
	100%	BY MANUFACTURER
	5%	BY BHEL
	NIL	BY CUSTOMER
	2) MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST.INSPECTING ENGINEER SHALL CHECK THE SAME	
	3) TYPE TEST REPORTS SHOULD NOT BE MORE THAN 5 YEARS OLD ELSE VENDOR HAS TO CONDUCT THE SAME AT THEIR OWN COST	

Instrumentation Check List

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to carry out ROUTINE TEST on 100 %.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR	ONE / LOT		P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

LCP & JUNCTION BOXES 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
Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)
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 in the data sheet – A (No. PES-145-54A-DS1-0).

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 as given in data sheet-A (No. PES-145A-DS1-0). 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 as given in data sheet-A (No. PES-145A-DS1-0) 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 as specified in data sheet-A (No. PES-145A-DS1-0) 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 as called for in the data sheet-A (No. PES-145-54A-DS1-0). 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 no. PES-145A-DS1-0
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 No. PES-145A-DS2-0
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.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145A-DS2-0

BHEL	**DATA SHEET FOR LOCAL PANELS**	SPECIFICATION NO.: PE-SS-999-145-054A	
		VOLUME	
		SECTION	
		REV. NO. 02	DATE: 16.09.2013
		SHEET 1 OF 3	

TAG No. ..... Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

	DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER		
	CONSTRUCTION	■ FOLDED ☐ WELDED	
	ENCLOSURE SHEET THICKNESS **(As per Section 8.13,Volume V of contract specification)** — FRONT	☐2.0 mm	
	OTHER	☐ 2.0 mm	
	DOOR	☐ 1.6 mm	
	HEIGHT	☐ 2365 mm for stand alone panels. ☐ Other	
	OTHER	☐ Load bearing sheet front shall have 3mm thickness	
TECHNICAL	INPUT POWER SUPPLY * **(As per Electrical specification)** (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)	☐ 240V 50 Hz AC ☐ 220V DC ■ 415V 3 PHASE 3W ☐ 400V 3 PHASE 4W	
	NO. OF FEEDERS **(As per Electrical specification)**	☐ ONE ☐ TWO	
	STARTER WITH MCC	☐ REQUIRED ■ NOT REQUIRED	
	IPR POSITION	■ MCC ☐ RELAY PANEL	
	CONTACT RATING OF RELAY	■ 5 Amp, 230 V AC ■ 0.25 Amp, 220V DC	
	CONTROL SUPPLY	☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)	_____NOS. (AS REQUIRED)	
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)	☐ REQUIRED ■ NOT REQUIRED	
	PAINT TYPE **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**	☐ EPOXY ENAMEL ☐ EPOXY POWDER COATED	
	MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)	■ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**	☐ LIGHT GREY ☐ OPALINE GREEN	
	FINISH (EXTERNAL) **(As per Annex-1, Section 7.6,Voulme IV of contract specification)**	☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**	☐ WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH (INTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**	☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION	■ IP-55 (FOR INDOOR SERVICE) ■ IP-67 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE	■ RELAY BASED	
	FOUNDATION ARRANGEMENT	☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)	.....(Vendor to specify)	

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A	
		VOLUME	
		SECTION	
		REV. NO. 02	DATE: 16.09.2013
		SHEET 2 OF 3	

TAG No. ..... Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	PANEL TYPE	☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
	CABLE GLAND	■ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT) *	☐ 1 Amp CT ☐ 4-20 mA	
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING	☐ APPLICABLE ■ NA	
	* TO BE CO-ORDINATED WITH PEM ELECTRICAL		

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI	NAME:
DESIGNATION	SR.ENGR	DY.MNGR	D. GM	
SIGNATURE				SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR LOCAL PANELS**	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 / DATE: 16.09.2013
		SHEET 3 OF 3

TAG No. ..... Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT		
		OTHER		
		DOOR		
		HEIGHT		
		OTHER		
TECHNICAL	INPUT POWER SUPPLY			
	NO. OF FEEDERS			
	CONTACT RATING OF RELAY			
	TEMP SCANNER			
	CONTROL SUPPLY			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)			
	PAINT TYPE			
	PANEL COLOUR (EXTERNAL)			
	FINISH (EXTERNAL)			
	TYPE OF MIMIC MATERIAL OF MIMC THICKNESS OF MIMIC			
	PANEL COLOUR (INTERNAL)			
	FINISH (INTERNAL)			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR LOCAL PANELS**	SPECIFICATION NO.: PE-SS-999-145-054A	
		VOLUME	
		SECTION	
		REV. NO. 02	DATE: 16.09.2013
		SHEET 3 OF 3	

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

PANEL TYPE			
CABLE GLAND			
AMMETER (TYPE OF INPUT)			
SCOPE OF SUPERVISION			

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTYAVA	MA MANSOORI	NAME:
SIGNATURE				SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

LCP Quality Plan

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
	INCOMING											
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Relevant standard	Relevant standard	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	Relevant standard	Relevant standard	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Relevant standard	Relevant standard	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	Relevant standard	Relevant standard	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

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1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type	CR	Visual	Sample	BHEL Spec. and BOM	BHEL Spec. and BOM	Log Book	2	---	---	
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	Relevant standard	Relevant standard	Log Book	2	---	---	
		3. Operation / Functional check	CR	Electrical	Sample+ 100%@	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	+ for relay & contactors only
		4. I.R.	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	
		6. Calibration	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	1	
		7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant standard & Catalogue	Relevant standard & Catalogue	Log Book	2	---	---	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
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SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	3 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
	IN PROCESS											
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
	ASSEMBLY											
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
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SECTION	D
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SHEET	4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
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SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	5 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
	FINAL											
12.	Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	6 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1	
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1	

At Random by BHEL, based on 100 % internal test reports by Mfr.

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	7 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant standard	BHEL approved spec/drg & relevant standard	Inspection Report	2	1	1	

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SPECIFICATION FOR ELECTRONIC POSITIONER

1.0 Electrical :

Input Signal	4-20mA
Power Supply	Loop Powered from the output card of Control System (12-30 V DC)
Hart Protocol	Compatibility for Remote Calibration & Diagnostic (Super-Imposed HART Signal on Input Signal to positioner (4-20mA)
Valve Position Feedback	4-20mA output signal for Position Feedback is to be provided to control system.

2.0 Environment :

Operating Temperature	(-) 30 To 80 Deg.C
Humidity	0-95%
Protection Class	IP-65 (Minimum)

3.0 Diagnostic Features :

Diagnostic / Test Features (to be available in Smart Positioner and shall be accessible through any HMS software)	**Minimum Diagnostic Features Like** • Measurement of Valve positioning timing, • Detection of actuator leakage, • Display of fault alarm. • Logging of alarms and history. • Valve friction/jamming detection. • Detection of valve wear & tear, • Valve stroke length and timing.
	Advanced Diagnostic Features Like (OPTIONAL, if specified in customer's specification) • On line partial closure test. • Valve signature analysis (online graphical/tabular representation of input signal Vs valve travel). • Step response test.

4.0 Software :

Software (to be supplied alongwith smart positioner)	• Windows based software to meet the requirement for configuration, diagnostics, calibration and testing of Valve and actuator. • Easily up-gradable with same hardware and compatible with any Hart Management Systems (HMS). • Shall be capable to cater to all the tags in the specification at the same time.

5.0 Hardware :

Hardware (As required)	1. PC with software for configuring and accessing diagnostic features of the positioners.
	2. Multiplexers for interfacing smart positioner with PC.
	3. Communication cable for interconnecting multiplexers with PC.
	4. RS232/RS485 converter (if required)

Note : Power supply for Multiplexer shall be arranged by the owner.

6.0 Valve Action :

Valve Action	**Direct & Reverse.** (Same positioner for Single Acting or Double Acting And no separate relays required for changing from Single acting to double).
	During Failure of input Electrical signal (4-20 mA), valve to attain fail Freeze position without any external hardware. (Sol valve, Power Supply etc.)

7.0 Flow Characterization :

Flow Characterization	Possible to fit valve characteristic curve linear & Equal percentage

8.0 Performance:

Characteristic Deviation	<=0.75% of span
Ambient temp effect	<=0.01%/Deg C or better.
Dead Band	Adjustable 0.1 to 10%.
Scan Time	10ms
Resolution	<=0.05%
Sensitivity/Linearity	0.3-0.4% of FS
Repeatability	0.32% of FS

9.0 Test Certificates:

Test Certificates/Test Reports for degree of protection, Accuracy and calibration test (as a minimum) to be submitted as per Manufacture Standard / Relevant Standard.

10.0 EMC & CE compliance

International Standard Like EN/IEC. To EN 50081-2 & EN 50082 or equivalent

11.0 Accessories

In Built Operator Panel	Display with push buttons for Configuration and display on the positioner itself
Hand Held Hart Calibrator (Optional)	Universal Hart Calibrator To Be Provided, One Per Unit.
Press Gauge Block	For Supply & Output Pr., Filter Regulator Other Accessories Shall Be Provided As per Control valve hook-up diagram.
Electrical cable entry	½ - NPT, side or bottom entry to avoid water Ingress.

DRAWING NO. PE-DG-999-145-IXXX

STANDARD

INSTALLATION DIAGRAM

(FOR INSTRUMENTS IN VENDOR SCOPE OF SUPPLY FOR MAUX PACKAGES)

743

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD

JOB NO. 999
STATUS STANDARD
DISTRIBUTION
TO
No. of

PROJECT: STANDARD

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
I	DESN	KT		05.11.13
	CHD	RV		05.11.13
	APPD	BS		05.11.13

TITLE: INSTALLATION DIAGRAM (FOR MAUX PACKAGES)

DEPT. SIGN DATE | SCALE

DRAWING NO. PE-DG-999-145-IXXX

SHEET 1 OF 9 | REV. 00

NOTES :–

1. IMPULSE PIPES SHALL BE OF SEAMLESS AND ANNEALED CONFORMING TO ANSI B36.10 IN LINE WITH THE MAIN PIPE MATERIAL.
2. PIPE FITTINGS SHALL BE OF FORGED MATERIAL CONFORMING TO ANSI B16.11–1991.
3. SNUBBER SHALL BE PROVIDED FOR PUMP DISCHARGE PRESS MEASUREMENTS.
4. IN CASE OF STEAM SERVICE SYPHON SHALL BE MADE BY BENDING THE TUBE OR PIPE.
5. VALVE MANIFOLDS & SNUBBER SHALL BE OF FORGED SS–316.
6. FOR SEA WATER APPLICATION SS316L FITTINGS TO BE PROVIDED.
7. 25NB x 15NB WELDED REDUCER SHALL BE USED FOR ROOT VALVE OF 25NB SIZE.
8. ROOT VALVES SHALL BE AS FOLLOWS:

   i) FOR PRESS <40 ATA & TEMP <425 DEG C, ONE(1) NO. 15Nb, ROOT VALVE OF SUITABLE CLASS SHALL BE USED.
   ii) FOR PRESS >40 ATA & TEMP <425 DEG C, TWO(2) NO. 15Nb, ROOT VALVE OF SUITABLE CLASS SHALL BE USED.
   iii) FOR PRESS >40 ATA & TEMP >425 DEG C, TWO(2) NO. 25Nb, ROOT VALVES OF SUITABLE CLASS SHALL BE USED.

9. HORIZONTAL PIPE RUNS SHOULD HAVE A SLOPE IN THE DIRECTION  SHOWN OF 1:20 AS MINIMUM.
10. FOR PRESSURISED STEAM & WATER SERVICE THE ASSOCIATED INSTRUMENT SHOULD BE MOUNTED BELOW THE TAPPING POINT. FOR VACUUM/AIR/GAS SERVICE, THE ASSOCIATED INSTRUMENT SHOULD BE MOUNTED ABOVE THE TAPPING POINT.
11. SEAMLESS PIPE/SEAMLESS TUBE/CAPILLARY LENGTH SHALL BE SUCH THAT THE GAUGES/TRANSMITTERS/SWITCHES ARE MOUNTED IN ACCESSIBLE AREA.

LEGEND :–

A/R – AS REQUIRED

NPTF – NATIONAL PIPE THREAD FEMALE

NPTM – NATIONAL PIPE THREAD MALE

SW – SOCKET WELD

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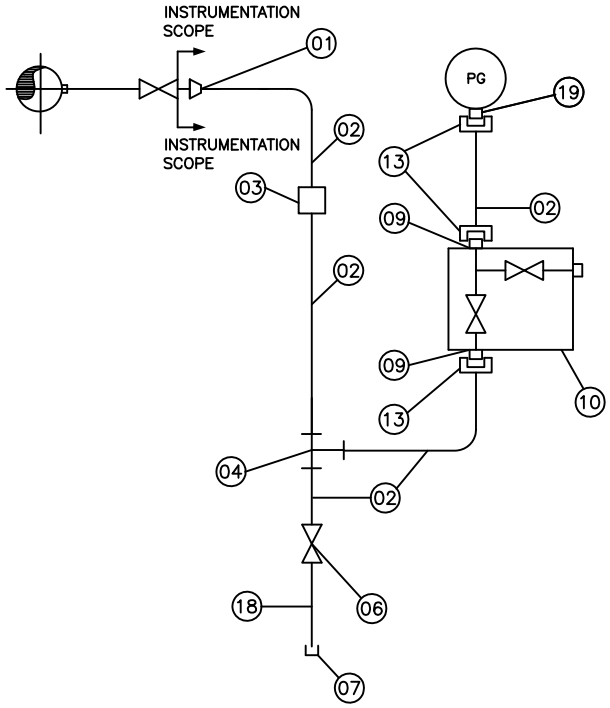
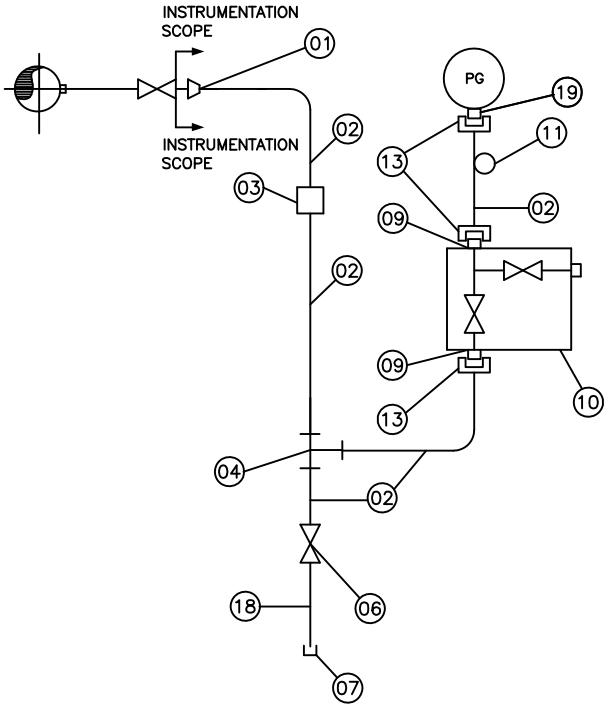
BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM NOTES	DRG. NO.	PE–DG–999–145–IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	2 OF 9	



WATER SERVICE



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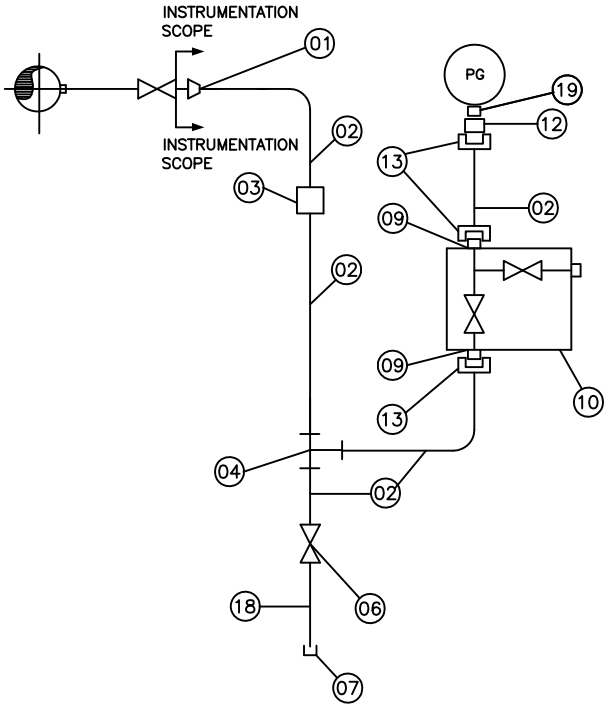
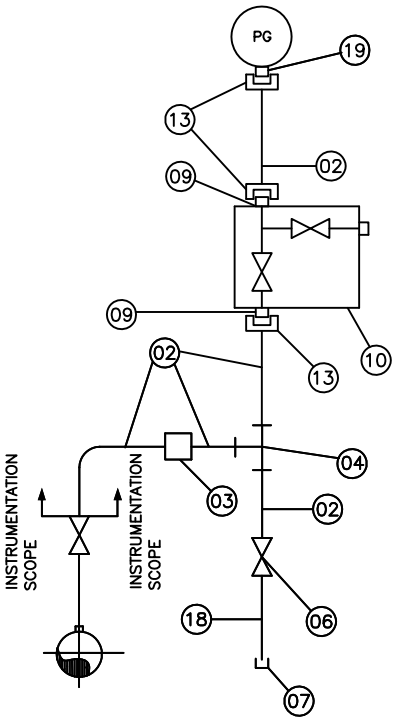


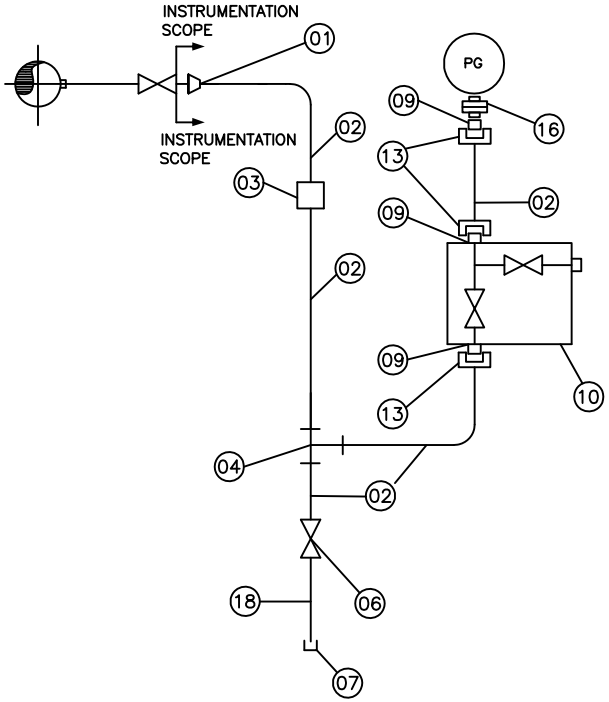
PULSATING SERVICE

745

BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM PRESSURE GAUGES	DRG. NO.	PE-DG-999-145-IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	3 OF 9	



AIR SERVICE

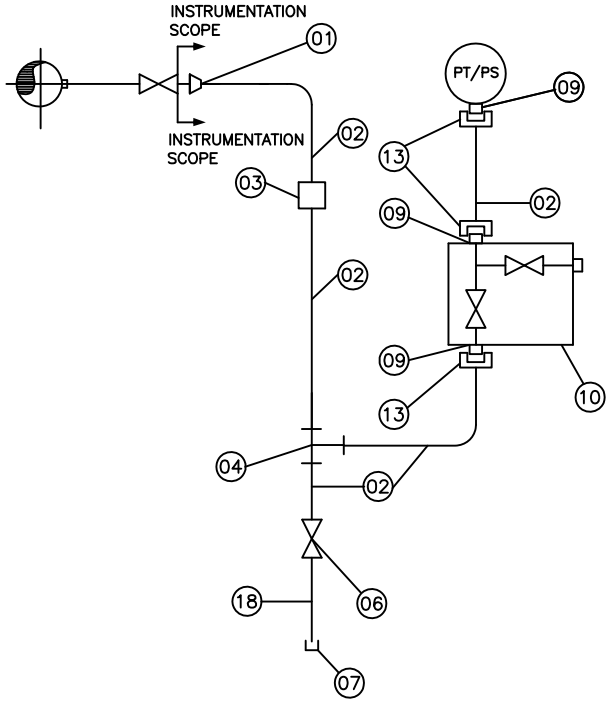


WITH CHEMICAL SEAL

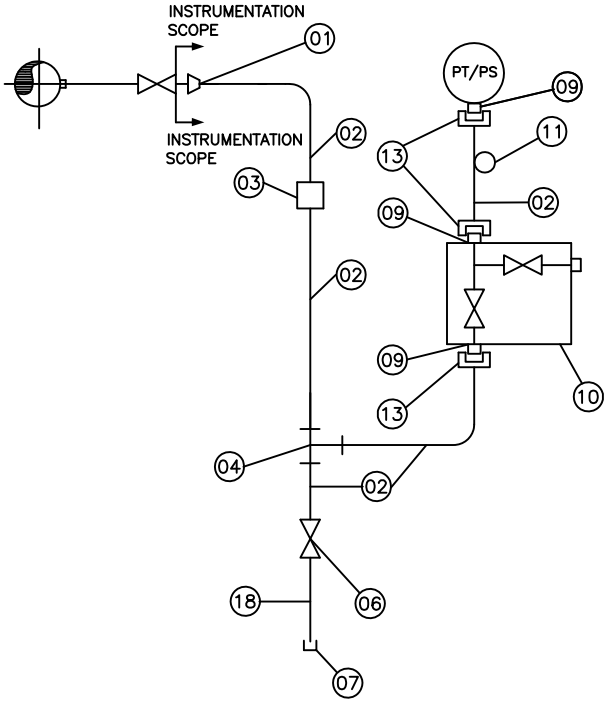
(FOR VISCOUS NON–CORROSIVE FLUID ONLY)

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY				
				WATER	STEAM	PULSATING	AIR	CHEMICAL
01	REDUCER (IF APPLICABLE)	SAME AS MAIN PIPE	1" X 1/2"SW	01	01	01	00	01
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R	A/R	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R	A/R	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	01	01	01	01	01
09	ADAPTER – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02	02	02	03
10	TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG	SS316	1/2" NPTF	01	01	01	01	01
11	SYPHON	SS316	1/2" SW	00	01	00	00	00
12	SNUBBER	SS316	M20X1.5M X M20X1.5F	00	00	01	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	03	03	03	03	03
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00	00	00	01
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	01	01	01	01	01
19	ADAPTER – M TO F	SS316	M20X1.5M X 1/2" NPTF	01	01	01	01	00

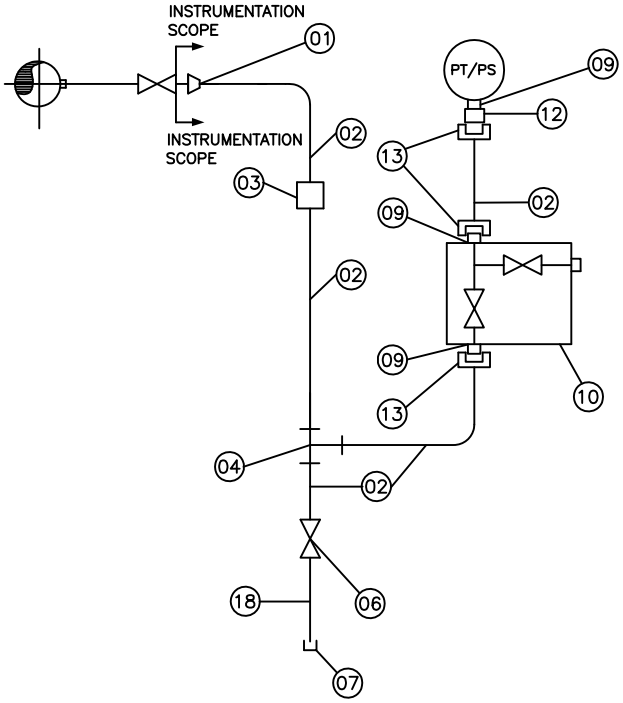
BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM PRESSURE GAUGES	DRG. NO.	PE–DG–999–145–IXXX
		REV. NO.	00 DATE 05.11.13
		SHT	4 OF 9



WATER SERVICE

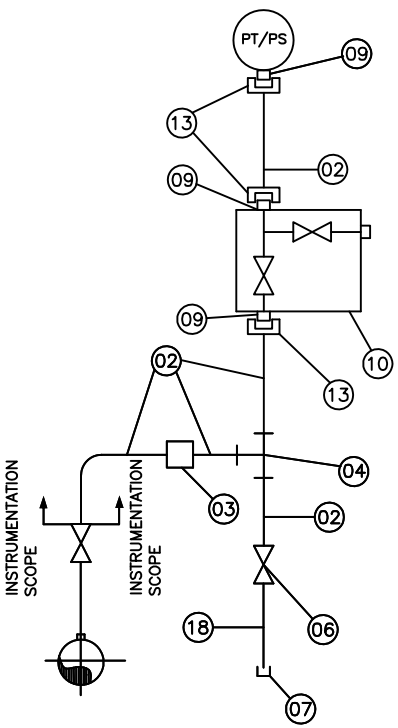


STEAM SERVICE



PULSATING SERVICE

TITLE :- INSTRUMENT INSTALLATION DIAGRAM PRESSURE SWITCHES/TRANSMITTERS	DRG. NO.	PE-DG-999-145-IXXX	
	REV. NO.	00	DATE 05.11.13
	SHT	5 OF 9	



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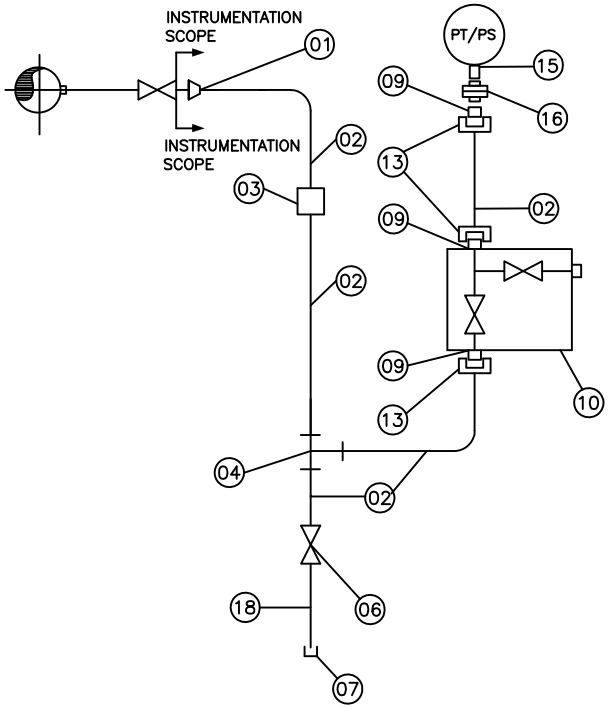
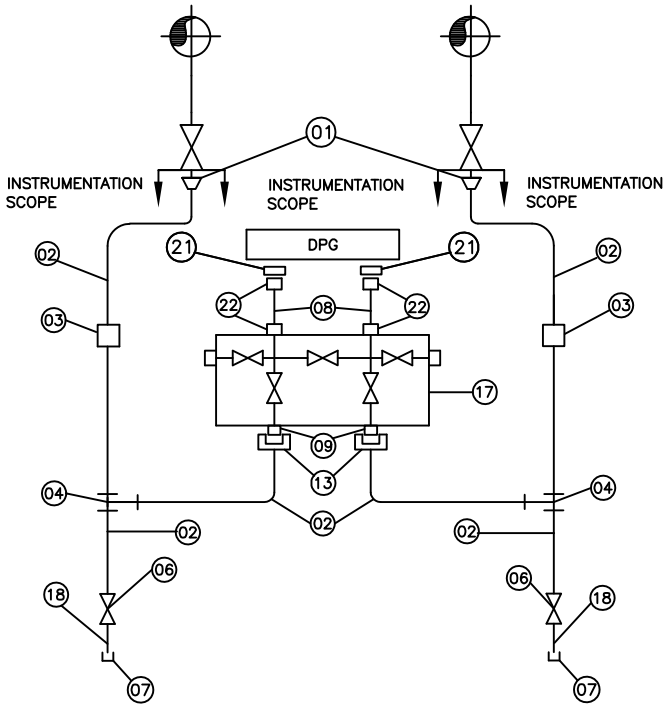


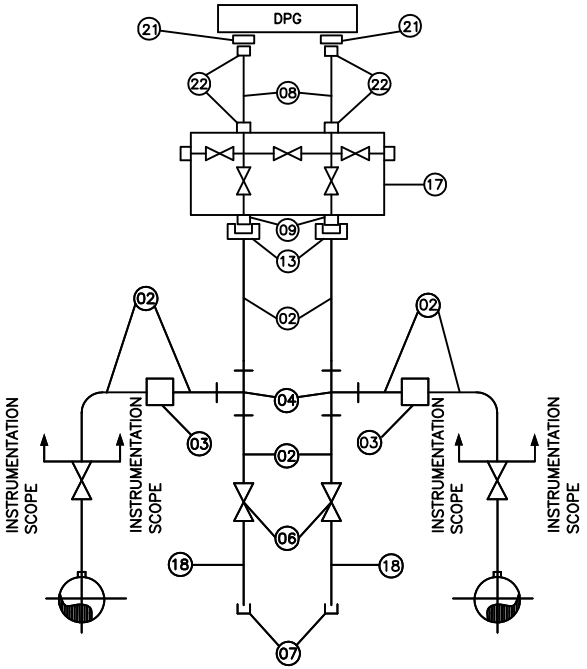
WITH CHEMICAL SEAL
(FOR VISCOUS NON–CORROSIVE FLUID ONLY)

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY				
				WATER	STEAM	PULSATING	AIR	CHEMICAL
01	REDUCER (IF APPLICABLE)	SAME AS MAIN PIPE	1" X 1/2"SW	01	01	01	00	01
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R	A/R	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R	A/R	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	01	01	01	01	01
09	ADAPTOR – M TO M	SS316	M20X1.5M X 1/2" NPTM	03	03	03	03	03
10	TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG	SS316	1/2" NPTF	01	01	01	01	01
11	SYPHON	CS	1/2" SW	00	01	00	00	00
12	SNUBBER	SS316	M20X1.5M X M20X1.5F	00	00	01	00	00
15	CONNECTOR – M TO M	SS316	1/2" NPTM X 1/2" NPTM	00	00	00	00	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00	00	00	01
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	03	03	03	03	03
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	01	01	01	01	01

BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM PRESSURE SWITCHES/TRANSMITTERS	DRG. NO.	PE–DG–999–145–IXXX
		REV. NO.	00 DATE 05.11.13
		SHT	6 OF 9



WATER SERVICE



AIR SERVICE

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				WATER	AIR
01	REDUCER (IF APPLICABLE)	SS316	1" X 1/2"SW	02	00
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	02	02
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	02	02
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	02	02
08	SEAMLESS TUBE	SS316	1/2" OD	A/R	A/R
09	ADAPTOR – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02
17	FIVE VALVE MANIFOLD WITH DRAIN PLUG	SS316	1/2" NPTF	01	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	02	02
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	02	02
22	TUBE FITTING DFDC	SS316	1/2" NPTM X 1/2"OD TUBE	04	04
21	CONNECTOR – F TO F	SS316	1/2" NPTF X 1/2" NPTF	02	02

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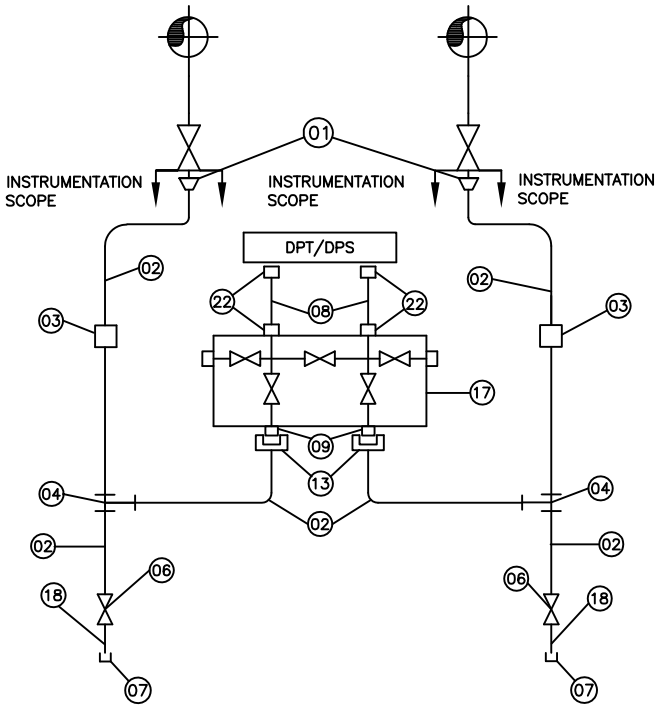
BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM DIFFERENTIAL PRESSURE GAUGES	DRG. NO.	PE-DG-999-145-IXXX
		REV. NO.	00 DATE 05.11.13
		SHT	7 OF 9



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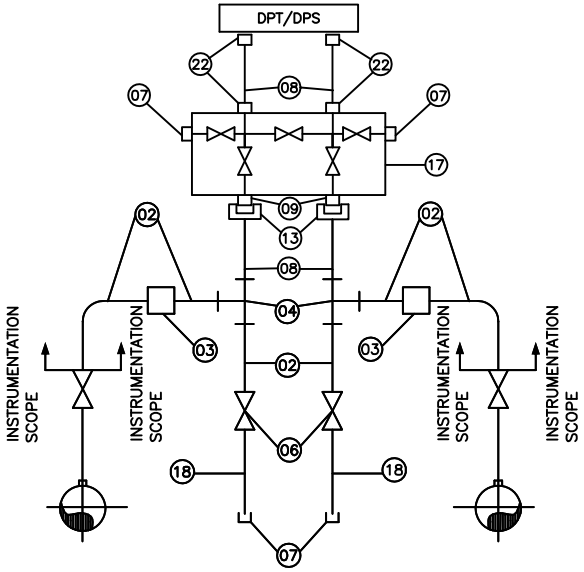
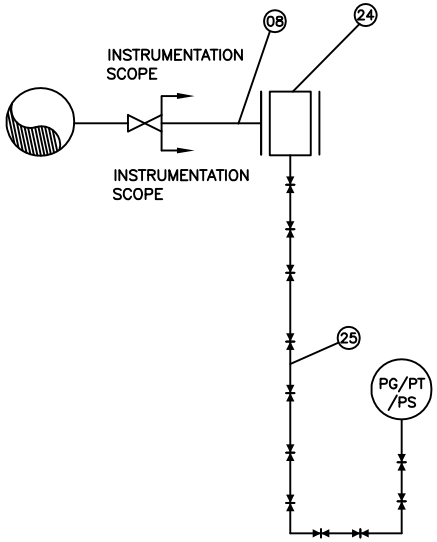


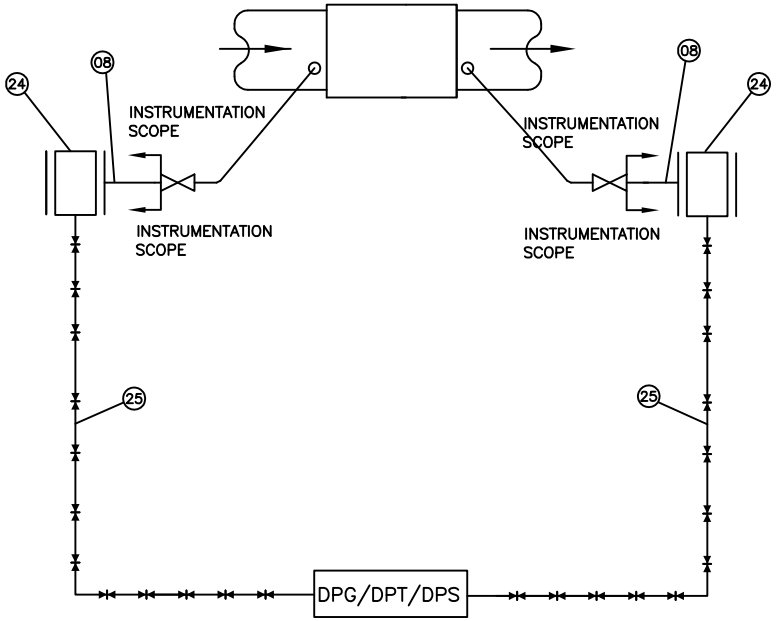
AIR SERVICE

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				WATER	AIR
01	REDUCER (IF APPLICABLE)	SS316	1" X 1/2"SW	02	00
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R
04	FORGED TEE	SS316	1/2" SW	02	02
06	FORGED GLOBE VALVE	SS316	1/2" SW	02	02
07	CAP	CS	1/2" NPTF	02	02
08	SEAMLESS TUBE	SS316	1/2" OD	A/R	A/R
09	ADAPTER – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02
17	FIVE VALVE MANIFOLD WITH DRAIN PLUG	SS316	1/2" NPTF	01	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00
15	CONNECTOR – M TO M	SS316	1/2" NPTM X 1/2" NPTM	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	02	02
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	02	02
21	CONNECTOR – F TO F	SS316	1/2" NPTF X 1/2" NPTF	00	00
22	TUBE FITTING DFDC	SS316	1/2" NPTM X 1/2"OD TUBE	04	04

BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM DIFFERENTIAL PRESSURE SWITCHES/TRANSMITTERS	DRG. NO.	PE-DG-999-145-IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	8 OF 9	

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				PG/PS/PT	DPG/DPS/DPT
24	FLANGE SUPPLIED WITH PG/PS PT/DPG/DPS/DPT TO SUIT 1/2" OR 1" NB PIPE	SAME AS MAIN PIPE	1/2" SW	01	02
08	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
25	SS ARMORED CAPILLARY TUBE (MINIMUM 5M IN LENGTH)	SS316	–	A/R	A/R





BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM WITH CAPILLARY TUBES	DRG. NO.	PE-DG-999-145-IXXX
		REV. NO.	00 DATE 05.11.13
		SHT	9 OF 9

KKS PHILOSOPHY

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A	A	Y	Y	B	B	B

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-**1.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

1) AC SYSTEM: QKA, QKB, ……upto QKZ

2) VENTILATION SYSTEM: SAA,SAB,……upto SAZ

ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level

CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

i) Use 10, 20, 30... To distinguish between main systems having same Alpha Codes. Examples:

a) Main Steam (Left) and Main Steam (Right)

b) BFP – A/B/C

c) ID Fan – A/B, FD Fan A/B, AH – A/B

ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.

iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

i) Valves and Dampers --- *Equipment Code – AA*

		N1	N2 N3
Motorised *(on/off duty)*	-	*0*	*01 to 50*
Motorised (inching duty)	-	*0*	*51 to 99*
Pneumatic (Control)	-	*1*	*01 to 50*
Motorised (thyrestor Control)	-	*1*	*51 to 99*
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99

NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99

ii) Field Instruments

Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			

Example of Numerical Key Usage:

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ……. Where system code is same.

MANDATORY SPARES

The equipment and all its components shall be placed with great care and accuracy and shall be aligned correctly to provide an installation consistent with the close tolerances used in the erection of modern equipment. The proper elevations and centrelines to which equipment is to be set shall be established by the contractor.

All necessary materials and labour for performing all the above tests shall be provided by the contractor. All test equipment and instruments shall be furnished by the contractor and will remain the contractor's property after the fulfilment of all field tests

All civil work required for foundation shall be carried by contractor. The contractor is required to submit all foundation drawings and supporting steels well in advance for approval.

18.10. FIELD TESTS

After installation, the HVAC system shall be field tested for operational tests, visual inspection of complete installations, main air flow rates, performance of heaters, electrical consumption of electrical components, room conditions in all rooms, control system, hydrostatical tests of whole piping systems, air tightness, vibration and noise due to turbulence in the duct assembly etc. The contractor shall prepare and hand over to Employer details of all test results in a report in a mutually agreed format.

18.11. SPARE PARTS

18.12. GENERAL SPARE PARTS

The Contractor shall supply the general spare parts as per relevant clauses of the tender specifications. The supply of this spares shall be as per the approved list of spares for each component / equipment / item during detail engineering. The following specified spare parts, which shall comprise the total requirement for HVAC system under this Contract, shall be supplied.

S. No.	Description	Unit & Quantity
1	Filter bank of each type and size	4 sets

Dy. General Manager,
M&U-Ganga Valley
UJVN Limited,
Ganga Bhawan, Dehradun

2	V- belts of each type and size	2 sets
	Relays of all type	2 sets
3	Circulation chilled water pump motor set	1 No.
4	Control system cards	1 set
5	All type of fuses and indicators	sets

A set is defined as the total number required for one unit.

18.13. SPECIAL TOOLS

The Contractor shall provide one set of all necessary special tools and maintenance equipment for repair and maintenance of the Air conditioning and Ventilation system as recommended by the manufacturer. A list of such tools shall be approved during detail engineering.

SIGNAL EXCHANGE WITH PLANT SCADA

OPC DATA INPUT FORMAT (FORMAT FOR SOFT SIGNAL EXCHANGE BETWEEN PLC & DDCMIS)

OPC Server IP Address
OPC Server Name

Group No	Tag No	OPC Name in Server	Description	R/W	Type of Signal	Engg Unit	Range
1	1						
	2						
	3						
	4						
2	1						
	2						
	3						

Remote Registration File - File to be sent and also to be copied in OPC PC under c:\custom\opc one file for each OPC device to be interfaced

Enter only Numbers under Group No and Tag No in ascending order
OPC Name is reference name by which client will access data
Description is details of a tag
R/W is read or Write or both Function
Type of signal is information type
Ex Process Parameter(Analog value) etc
or Process Status (Digital Value)
Engg units if applicable
Range if applicable
Provide Technical Manual
Reqd. Contents : This document must provide an overview of the device including its intended use(a general technical,communication & electrical details)

CABLE LIST FORMAT

Cable Schedule format

UnitCableNo	FROM	TO	Purpose	CableSize	REMARKS	PATHCABLENO

LIST OF DELIVERABLES

4X36 MW UJVNL, CHILLA HEP, RMU
HVAC SYSTEM
LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT

DOCUMENT NUMBER PE-GL-999-145-I100

Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	FROM	USER	REMARKS
		INSTRUMENTATION				
1	PE-V9-464-571-I901	INSTRUMENT DATA SHEETS $	A	VENDOR	C&I	
2	PE-V9-464-571-I902	BOQ	I	VENDOR	C&I	
3	PE-V9-464-571-I903	INSTRUMENT QP / CHECK LIST $	A	VENDOR	C&I	
		PLC PANEL				
1	PE-V9-464-571-I911	PLC DATA SHEET	A	VENDOR	C&I	
2	PE-V9-464-571-I912	PLC CONFIGURATION DRAWING	A	VENDOR	C&I	
3	PE-V9-464-571-I913	CONTROL SCHEMES (BLOCK LOGIC)	A	VENDOR	C&I	
4	PE-V9-464-571-I914	POWER DISTRIBUTION SCHEME	A	VENDOR	C&I	
5	PE-V9-464-571-I915	PANEL EXTERNAL GA DRAWING (INCLUDING FOUNDATION DETAILS & FLOOR CUT-OUT)	A	VENDOR	C&I	
6	PE-V9-464-571-I916	PANEL INTERNAL GA DRAWING	A	VENDOR	C&I	
7	PE-V9-464-571-I917	CONTROL DESK LAYOUT / GA DRAWING	A	VENDOR	C&I	
8	PE-V9-464-571-I918	PLC CONTROL ROOM LAYOUT DRAWING	A	VENDOR	C&I	
9	PE-V9-464-571-I919	INPUT / OUTPUT LIST	A	VENDOR	C&I	
10	PE-V9-464-571-I920	ANNUNCIATION LIST	A	VENDOR	C&I	
11	PE-V9-464-571-I921	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE)	A	VENDOR	C&I	
12	PE-V9-464-571-I922	PROCESS GRAPHIC MANUSCRIPTS	A	VENDOR	C&I	
13	PE-V9-464-571-I923	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	A	VENDOR	C&I	
14	PE-V9-464-571-I924	CABLE SCHEDULE & INTERCONNECTION	I	VENDOR	C&I	
15	PE-V9-464-571-I925	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	VENDOR	C&I	
16	PE-V9-464-571-I926	PANEL HEAT DISSIPATION DATA	I	VENDOR	C&I	
17	PE-V9-464-571-I927	BILL OF MATERIAL	I	VENDOR	C&I	
18	PE-V9-464-571-I928	PLC QUALITY PLAN	A	VENDOR	C&I	
19	PE-V9-464-571-I929	PLC O & M MANUAL	I	VENDOR	C&I	

$: DATA SHEETS AND QUALITY PLANS FOR ALL INSTRUMENTS AS APPLICABLE.

SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATIONS

SECTION-D

AIR HANDLING UNITS

1. GENERAL

1.1 This specification covers the design, manufacture, Construction features, installation, commissioning, inspection and performance testing at site of AHUs.

2. CODES AND STANDARDS

2.1 The design manufacture and performance of AHU shall comply with all currently applicable statutes, regulations and safety codes in the locality where the AHU is to be installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this spec. shall be construed to relieve vendor of this responsibility. In particular the equipment shall conform to the latest editions of the following standards:

2.1.1 IS-659 : Safety code for air conditioning

2.1.2 IS-660 : Safety code for mechanical refrigeration

2.1.3 ASHRAE : Method of testing forced circulation air-cooling and air heating coils. standard 33

2.1.4 ARI 41 : Standard for forced circulation air cooling and air heating coils.

2.1.5 ARI 430/435 : Air-cooling and air heating coils Central Station AHU / Application of Central Station AHU.

2.1.6 AMCA : 211 and 311

In case of any conflict in the standards and this specification the decision of PEM,BHEL shall be final and binding.

3. CONSTRUCTION FEATURES

3.1 The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m^3 density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof.

Necessary arrangement shall be provided on the casing for measuring temperature and pressure in cooling/heating coil. Class of instruments shall be min. 2.

3.2 Fan impeller shall be forwardly/backwardly inclined curved blade centrifugal type. Impeller shall be double width double inlet type. Fans shall be preferably low rpm (<=1500) to minimize vibration and noise. Noise shall be within 85 dB(A) at 1 metre distance from AHU casing. Max. Vibration level shall be acceptance and norms to be specified. Two to three wheels (impellers) shall be provided for each AHU. Impeller blades shall be fabricated from (min. 1.0 mm) galvanized/ epoxy powder coated sheet steel. Fan shall be of epoxy powder coated / galvanized sheet steel (min. 1.6 mm) scroll with die formed inlets for uniform air flow. Fan shafts shall be solid cold rolled carbon steel (EN8 normalised), ground and polished. Fan shaft bearings shall be of heavy duty type selected for average operating life of 100,00 hours. Bearings shall be self-aligning, permanently lubricated type. Make of Brgs(SKF/FAG/NORMA/TATA) to be specified. Bearing Housing shall be of casting of min. IS Gr. 210, split type and

suitably supported. The V-belt drive with belt guard shall be provided. Motors shall have minimum 15% margin over maximum BHP in working range.

3.3 Cooling water cooling coils and steam/hot water coils shall be internally corrugated copper/ cupronickel tubes (as per manufacturer's standard) with smooth non corrugated external fins of aluminium (thickness 0.14 mm and grade 1100 as per spec) unless specified otherwise in specification. At least 5 fins /per cm. shall be provided. The cooling water coils shall have suitable (standardize class, size, threading) drain and vent connections.

3.4 The filters in the filter section shall be provided as detailed in data sheet A.

3.5 Humidifier shall be Pan type/as specified in the specification.

Pan type Humidifier consisting of SS304/316 tank, heater, geyserstat with piping connection to supply air duct shall be provided unless specified otherwise in data sheet A.

Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.

3.6 Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room.Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized

3.7 Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU.

The AHU shall be provided with 18 G SS drain pan.

4. TESTING AND INSPECTION AT MANUFACTURERS WORKS:

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

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

4.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating. For pipes and fittings compliance report shall be furnished by Manufacturer for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

4.3 Shaft: Mechanical and chemical.

4.4 Motors (of approved make): Routine TC.

4.5 Workmanship and dimensional check as per manufacturing drg. and approved Drgs.

4.6 Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked to avoid loosening. Balancing weights and fasteners used shall be galvanized.

4.7 Performance test of one Centrifugal fan/per type/per size as per AMCA standard (for indigenous make).

4.8 Centrifugal fans for AHUs will be 100% run tested by main contractor of BHEL. One centrifugal fan/per type/per size will be run tested. Vibration shall be within good zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

4.9 Complete assembly of one AHU/per type/ per size (excluding cooling coil and filter) shall be witnessed.

4.10 Run test of one complete assembly/per type/per size (excluding cooling coil and filter). Vibration shall be within satisfactory zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

5. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

5.1 GA drawing of AHU & data- sheet to be submitted along with technical schedules enclosed in Volume III.

5.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.

5.3 Installation and erection manual.

5.4 Inspection, operation & Maintenance Manuals.

5.5 Equipment description giving complete design calculations, basis of design, selection criteria etc.

5.6 Test Certificates.

5.7 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

5.8 Performance Test Certificates.

5.9 Vendor shall also provide soft copy of each drawing in AutoCAD format.

5.10 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

	TITLE	SPECIFICATION NO. PES- 571-11000-A-002
BHEL	**AIR HANDLING UNIT** **DATA SHEET - A**	VOLUME - II-**B** SECTION - D REV 00 | DATE JAN 2020 SHEET 1 OF 2

	DESCRIPTION	**DATA**
1.	Nos. required/working	: Refer to Section-C of Specific technical requirement.
2.	Location	: Refer to Section-C of Specific technical requirement.
3.	Service/type	: Ventilation /Double skin.
4.	Fan type	: Centrifugal (forward/backward curve Blade) limit load.
	a) Capacity	: To Suit as per calculation.
	b) Static pressure	: To suit but not less than 100 mm wc for AHU's with pre filters.
	c) Discharge direction	: To suit layout.
	d) Motor	: By Bidder,
	e) Local push button station (Start/Stop)	: By Others
	f) Motor location	: Inside AHU Casing.
	g) Drive	: Belt, pulley, belt guard.
5.	Face and Bypass Damper	: Not Required
6.	Cooling coil	
	a) Duty sensible heat	: To suit as per calculations
	b) Duty latent heat	: -do-
	c) Type of coil	: Cooling Water.
	d) No. of rows	: To suit but not less than four (4)
	e) Material of tube /Thickness	: Seamless Copper to ASTME-75/Equivalent.
	f) Material of fins	: Aluminium to SAE-1100-/1145-0
	g) Number of fins	: Not greater than 5 per cm (13 per inch).
	h) Max. face velocity	: 2.5 m/sec.
	i) Air flow quantity	: To suit as per tender drawings/documents.
7.	3 - way motorised mixing valve with thermostat.	: Required with thermostat & actuator for cooling water system for each AHU.

8.	Damper at discharge	: Manually operated at discharge of each AHU outlet.
	a) Material of construction	: Mild Steel, galvanised.
9.	Filters	
	a) Type & thickness	: Dry panel type/ 50 mm
	b) Filter area. as specied in section-c.	: To suit as per velocity requirements. "V" – Bank-
	c) Filter efficiency 20micron	: Average arrestance efficiency of 80 % down to
	d) Press drop (Clean)	: Not to exceed 2.5 mmwc when clean & 6.5 mmwc while dirty.
10.	Humidification section	: As per the System requirement.
	a) Type	: Pan type, unless otherwise specified.
	b) Operation	: Automatic with Humidification.
11.	Fresh air arrangement	: Required.
	a) Fresh air fan	: Tube axial flow fans with motor.
	b) Accessories	: i) Inlet cone with Bird screen. : ii) Dry panel pre-filters, : iii) High efficiency filters for control room areas. : iv) Volume Control Dampers, : v) Supports etc.
12.	Vibration isolator required.	: Yes
13.	Type of vibration isolator.	: Neoprene ribbed Rubber for AHU's.
14.	Any other requirement	: i) In addition to dry panel filters on AHU, High efficiency filters (average arrestance efficiency of 80-90 %) shall be provided in supply air duct side of AHU for all power house and transformer cavern and allied areas. : ii) Bidder to also provide suitable electrical strip heaters for winter heating & monsoon reheating with Contactor box etc. Heaters to be interlocked with airstat.
15.	Instrument & controls	: Lot.(including Control box for strip heaters, pan humidifiers etc. in each AHU room.)
16.	Insulation of drain piping	: Lot.

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 IS:4894 -Centrifugal fans

2.1.2 IS:3588 -Electric Axial Flow fans

2.1.3 IS:2312 -Propeller type A.C. ventilation fans

2.1.4 IS-3963 -Roof extractor units

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

2.1.6 AMCA publication 99 standards handbook

2.1.7 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 requirments 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.

6. 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

7. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

7.1 GA drawing & data- sheet to be submitted along with technical schedules enclosed in Volume III.

7.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.

7.3 Equipment description giving complete design calculations, basis of design, selection criteria etc.

7.4 Test Certificates.

7.5 Performance Test Certificates.

7.6 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

7.7 Installation and erection manual.

7.8 Inspection, operation & Maintenance Manuals.

7.9 Vendor shall also provide soft copy of each drawing in AutoCAD format.

7.10 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

	TITLE	SPECIFICATION NO. PES-571-11000-A-03	
BHEL	**CENTRIFUGAL FAN**	VOLUME II-B	
	DATA SHEET - A	SECTION D	
		REV 00	DATE: JAN 2020
		SHEET 1 OF 2	

No.	Particulars	Data
1	**General Information**	
1.1	Fan Designation/application.	Refer schedule of Ventilation system.
1.2	Nos. required/capacity	Refer Section-C of Specific Technical Requirement
1.3	Location	Refer layout drg. Attached.
2.0	**Design Data**	
2.1	Type	DIDW for Ventilation
2.2	Type of blades	backward curved
2.3	Arrangement	To suit application as per layout.
2.4	Discharge direction	To suit application as per layout.
2.5	Duty	Continuous
2.6	Capacity at site (Cubic Meter/hr) & static pressure.	Refer Section-C of Specific Technical Requirement
2.7	Suction pressure (mm Wg)	As per system requirement.
2.8	Fluid	Atmospheric Air.
2.9	Suction Temperature	Refer weather data attached.
2.10	Suction humidity	Refer weather data attached.
3.0	**Materials**	
3.1	Fan Scroll	Heavy Gauge Mild Steet to IS: 2062 with galvanised
3.2	Fan Casing (side plates & stiffeners)	Heavy Gauge Mild Steet to IS: 2062 / IS: 1079 / Eq. Minimum 3 mm thick casing.
3.3	Impeller	Mild Steel/plate to IS: 2062
3.4	Impeller hub	Mild Steet/plate to IS: 2062
3.5	Impeller back plate blade & shroud	Mild Steet to IS: 2062 / IS: 1079 / Eq.
3.6	a) Shaft b) Shaft sleeve	EN-8 or eqv. -do-
3.7	Support frame and structure.	Mild Steet to IS: 2062
3.8	Flexible connection at outlet canvas with MS Flanges and cleats (3mm thick).	Fire resistant type plastic impregnated

3.9	V Belt	ISI marked (Reinforced rubber section to IS: 4776)
3.10	V Pulley	Cast Iron multi groove to grade FG 20 as per IS: 210. Having taper lock type
3.11	Slide rails	M.S./C.I.
3.12	Connection pieces	G.I. according to supplier's design
3.13	Bolts & nuts	M.S. Galvanized / Epoxy painted.
3.14	Vibration isolating pads, washers and spring if any.	Hard synthetic rubber
4.0	**ACCESSORIES**	
4.1	Common base plate	Required.
4.2	Anchor bolts	-do-
4.3	Vibration Isolators	Hard synthetic rubber
4.4	V-belt pulleys	-do-
4.5	V-belts	Reinforced rubber of appropriate section
4.6	Belt guard	Required.
4.7	Outlet damper	Required(M.S. Heavy Gauge)
4.8	Inlet guard	Required.
4.9	Inlet Vane (variable)	Not required.
4.10	Drain valve	Required.
4.11	Acoustic silencers	Not required.
5.0	**Motor**	
5.1	Motor by	Bidder
5.2	Starter by	Bidder
6.0	Painting of fans including base frame	Galvanized / epoxy painting (as per Section-C & painting specifications)

NOTE:

1) Motors shall have 15 % margin on duty power point.

2) Fan shall be designed to operate with in 9% and 25% of system throttling line.

3) Opposed Multiple louvers damper shall be provided at fan outlet.Louvres shall be of 2 mm thick MS (galvanized). Casing shall be of 3.15 mm thick MS (galvanized).

	TITLE	SPECIFICATION NO. PES-571-11000-A-03	
BHEL	**Ventilation Fan (Axial Flow Type)**	VOLUME II-B	
	DATA SHEET - A	SECTION D	
		REV 00	DATE: JAN 2020
		SHEET 1 OF 2	

No.	Particulars	Data
	General Information	
1)	Designation	Supply/Exhaust Fans.
2)	Nos. required	Refer schedule of Ventilation system in section-C 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 Section'C' schedule of ventilation system.
11)	Outlet Air Velocity	Not more than 12 m/sec.
	Materials	
12)	Casing	M.S. (IS-2062)
13)	Impeller	Cast A1uminium. (Alloy A-6M, IS-617)
14)	Hub	Al Alloy.
15)	Support frame and structure. (Galvanized/	M.S. of adequate thickness Painted) IS-2062.
16)	Neoprene rubber pads	As required.
17)	Coned inlet for wall exhausters/supply fans	MS (IS-2062)
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	Bidder

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

CENTRIFUGAL PUMPS

1. GENERAL

1.1 This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer's or his subcontractor's works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter.

2. CODES AND STANDARDS

2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable):

2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water.

2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump.

2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water.

2.1.4 BS - 599 : Method of testing Pumps.

2.1.5 PTC - '6' : Centrifugal Pumps Power test code

2.1.6 API - 610

2.1.7 Hydraulic Institute Standards of USA

Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards.

2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser's engineering shall be final and binding.

3. DESIGN REQUIREMENTS

3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability.

3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards..

3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.

3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A.

4. CONSTRUCTION FEATURES:

4.1 **PUMP CASING**

4.1.1 Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand 1.5 times the maximum pressure developed by the pump at the pumping temperature.

4.1.2 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves or plugged with threaded plugs as required.

4.1.3 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.

4.1.4 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610

4.2 **IMPELLER**

4.2.1 Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be checked for eccentricity and statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity. Supplier shall ensure during balancing that wall thickness of impeller vane, shroud etc is maintained above the minimum thickness requirement as per design.

4.3 **WEARING RING**

4.3.1 Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

4.4 **SHAFT**

4.4.1 Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runway speed.

4.5 **BEARING**

4.5.1 Bearings and hydraulic devices**,** of approved make, (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.

4.6 **STUFFING BOX**

4.6.1 Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer. Tubings used for connections shall be flexible metallic type preferably SS-304/316. PVC/ rubber tubings are not acceptable.

4.7 **SHAFT COUPLING**

4.7.1 The pumps shall be directly coupled to their drives through heavy-duty flexible coupling. Suitable sturdy coupling guards of min. 1.5 mm MS sheet/ Aluminium sheet shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

4.8 **BASE PLATE AND SOLE PLATE**

4.8.1 Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided. The external corners of the base plate shall be rounded to avoid sharp corners. Drilled holes shall have sufficient space around for proper seating of washer with nut. If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 **PRIME MOVER**

4.9.1 The drive motor selected shall conform to the requirements of the enclosed motor specifications.

4.10 **LIFTING ARRANGEMENT**

4.10.1 Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance..

5. PERFORMANCE REQUIREMENTS

5.1 The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.

5.2 Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.

5.3 Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.

5.4 The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.

6. DRIVE RATING

6.1 The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.

6.2 In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.

6.3 The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

7. SCOPE OF INSPECTION AND TESTING

7.1 CASTING

7.1.1 The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.

7.1.2 Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.

7.1.3 Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.

7.1.4 Verification of Heat treatment charts (as applicable)

7.1.5 Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.1.6 Surface finish of Steel castings shall meet MSS SP-55.

7.2 **FORGING**

7.2.1 Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.

7.2.2 Verification of heat treatment charts (time temperature) (as applicable).

7.2.3 Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.3 **FABRICATED ITEMS**

7.3.1 Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.

7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel as per ASME Sec IX.

7.3.3 Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8

7.3.4 Verification of heat treatment charts (time temperature), (as applicable)

7.3.5 **Note:** For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.

7.4 **IN PROCESS INSPECTION AND TESTING**

7.4.1 Identification Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. Permissible defects and acceptance norms need to be specified. On static parts acceptance norms are as per ASME Sec.III NB 2546.

7.4.2 Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness) as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency.

7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable

a) Cracks, flakes, seams and laps

b) Defects giving indications longer than that from a 4mm equivalent flaw.

c) Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%.

d) Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.

7.4.4 For static duty components - as per NB 2542.2 of ASME Sec. III

7.4.5 Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage.

Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures

7.4.6 Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.

7.5 **PERFORMANCE TEST**

7.5.1 Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked.

a) Capacity V/s Head

b) Capacity V/s Power absorbed by pump

c) Capacity V/s pump efficiency

Note : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity.

7.5.2 NPSH test in case specifically mentioned elsewhere.

7.5.3 Vibration, noise level and temperature rise measurement. Noise level shall be within 85dB(A) at 1 metre distance. Vibration within satisfactory zone of VDI 2056 Group G machines. Temperature shall not exceed ambient + 40 deg. C.

7.5.4 Overall dimensions as per GA drawings. One pump/type/size assembly with job motor shall be mounted on base plate, provided the components are ordered on the same manufacturer.

7.5.5 Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.

7.5.6 Painting and packing as per technical specification.

7.6 **TEST AT SITE**

7.6.1 The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.

7.7 **PERFORMANCE GUARANTEE**

7.7.1 The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification. The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head

8. CLEANING, PROTECTION , PAINTING & PACKING

8.1 Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere. Flanges, inlet and outlet pipe, etc shall be protected. Packing shall be done as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere.

9. DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

9.1 Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include:

a) Foundation base plate and sole plate details as applicable

b) Civil foundation and anchor bolts details and loading data

c) Minimum submergence required for the pump (if applicable)

9.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction and/ make with standard applicable codes.

9.3 Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.

9.4 Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.

9.5 Experience list about the supply and successful operation of similar pumps for similar application.

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

9.7 Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.

9.8 Data sheet-B with all the particulars filled in.

10. MANUFACTURERS NAME AND TAG. PLATES

10.1 Each pump shall have a permanently attached brass/ Stainless steel tag on the body indicating the following information both in Hindi and English:

a) Manufacturer's name and trade mark.

b) Design Capacity and Head.

c) Design.

d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

11. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

11.1 Certified GA drawings of pump motor assembly weights, crane.

11.2 Detailed cross sectional drawings of the pump and motor assembly and all equipment & accessories supplied under the this specification along with details of material of construction with applicable standard codes.

11.3 Foundation drawings with details of foundation pocket indicating static as well as dynamic load and other data with dimensions.

11.4 Certified characteristics curves (discharge capacity vs. head, BHP and efficiency) of each type of pump and motor.

11.5 Material and other test certificates as required by the application clauses of this specification.

11.6 Motor speed torque curves super imposed on pump speed torque curves.

11.7 Quality plan along with complete details of testing and inspection requirements of centrifugal pumps in BHEL format. Vendor shall also furnish Field Quality Plan.

11.8 Installation , operation and maintenance manual.

11.9 Other drawings and data, if necessary.

11.10 Vendor shall also provide soft copy of each drawing in AutoCAD format.

11.11 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

	TITLE	SPECIFICATION NO. PE-TS-413-571-11000-A004.
BHEL	**CENTRIFUGAL PUMPS** **DATA SHEET - A**	VOLUME II-B SECTION D REV 00 DATE: JAN 2020 SHEET 1 OF 2

DESCRIPTION		**DATA**
1.	Designation	: Cooling Water pumps for Ventilation plant.
2.	Type	: Horizontal, Centrifugal pump or vertical split type casing pump .
3.	Quantity	: Refer to section-C of Specific Technical Requirements
4.	Installation	: On floating type foundation.
5.	Fluid to be handled	: Water
6.	Temperature of fluid	: To suit.
7.	Capacity M3/hr and TDH at rated	: To suit system requirements but head shall not be less than 25 MWC.
8.	Duty	: Continuous (24 hours / day)
9.	Suction condition	: Flooded
10.	Type of drive	: Direct
11.	Prime Mover	: LV AC motor
12.	Maximum speed	: 1500 RPM
13.	Type of lubrication	: Grease Lubrication
14.	Material	
	a) Impeller	: Refer to section-C of Specific Technical Requirements
	b) Pump shaft	: Refer to section-C of Specific Technical Requirements
	c) Casing	: Refer to section-C of Specific Technical Requirements
	d) Wearing ring	: Refer to section-C of Specific Technical Requirements
	e) Shaft Sleeve	: Refer to section-C of Specific Technical Requirements
	f) Base plate	: Refer to section-C of Specific Technical Requirements
	g) Bolt and nuts.	: Refer to section-C of Specific Technical Requirements
	h) Stuffing Box gland/bush	: Refer to section-C of Specific Technical Requirements

i) Stuffing box Packing. : Refer to section-C of Specific Technical Requirements

j) Pump motor coupling. : Refer to section-C of Specific Technical Requirements

15. **ACCESSORIES REQUIRED:-**

The following accessories shall be provided by the bidder for each pump:

a) Suction & Discharge pressure gauges. : Yes.

b) Vent connection : Yes.

c) Drain piping up to common drain point in plant room. : Yes

d) Companion flanges. : Yes

e) Common base plate. : Yes.

f) Suction strainer. : Yes

g) Isolating valve : Yes

h) NRV at pump outlet at inlet/outlet : Yes

i) Any special requirements : The Cooling Water pumps shall be suitably insulated as per spec.

j) Inspection & Testing : As per specification enclosed elsewhere.

SECTION-D

PACKAGE AIR CONDITIONING UNIT

1 GENERAL

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

2 CODES AND STANDARDS

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

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

2.1.1	I.S.660	: Safety code for Mechanical Refrigeration.
2.1.2	I.S.5111	: Code of practice for measurement, and testing of refrigerant compressor.
2.1.3	I.S.659	: Safety code for air conditioning.
2.1.4	I.S.2494	: V Belt for industrial purpose.
2.1.5	I.S.3142	: V grooved pullies for V Belts.
2.1.6	I.S.4503	: Shell and tube type heat exchanger.
2.1.7	ARI 210	: Standard for/unitary air conditioning equipment
2.1.8	ARI 270	: Standard for application installation and servicing of unitary equipment.
2.1.9	ASHRAE-37	: Standard methods of testing for rating unitary air conditioning and heat pump / equipment.
2.1.10	ANSI-B9-1	: Safety code for mechanical refrigeration.

3 DESIGN AND CONSTRUCTIONAL REQUIREMENTS

3.1 Compressor

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

3.2 Condensing unit

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

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

3.2.2 Drain plug, air vent and test valve.

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

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

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

3.3 AIR HANDLING FAN

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

3.4 Filters

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

3.5 Cooling Coil

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

3.6 Controls

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

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

3.7 Refrigerant Piping

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

3.8 Cabinet

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

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

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

3.9 Other Accessories

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

4 CONTROL AND INTERLOCK REQUIREMENTS

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

The interlocking requirement shall be as indicated below:

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

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

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

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

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

5 TEST AND INPSECTION

5.1 Inspection and Testing at Manufacturer's Works

5.1.1 static and dynamic test for fans

5.1.2 Hydrostatic static test on condenser and cooling coil.

5.1.3 vacuum/pressure test for the complete refrigeration circuit.

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

5.1.5 Free running test on compressor.

5.1.6 AIR CAPACITY WITH ANEMOMETER.

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

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

5.2 Inspection and Testing at Site

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

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

5.2.1.1 Condenser inlet and outlet pressure and temperature

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

5.2.1.3 Motor current for the compressor and blower.

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

Room temperature (Dry & wet bulb)

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

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

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

6 PAINTING:

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

7 GUARANTEES

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

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

8 NAME PLATES

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

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1 Final technical data as per Data Sheet-A

9.2 G.A. and interior view of packaged unit

9.3 Electrical wiring diagram

9.4 Catalogues for all controls

9.5 O & M Manual

9.6 Erection Manual

9.7 Vendor shall also provide soft copy of each drawing in AutoCAD format.

9.8 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

	TITLE	SPECIFICATION NO. PES-571-11000-A-05	
BHEL	**PACKAGE AIR -CONDITIONING UNIT** **DATA SHEET - A**	VOLUME II-B	
		SECTION D	
		REV 01	DATE: JAN 2020
		SHEET 1 OF 1	

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

SECTION-D

AIR FILTER

1. GENERAL

This specification covers the design, manufacture, inspection and testing at manufacturer's work or his sub-contractor's works of Air filters to be used for air-conditioning and ventilation system.

2. CODES AND STANDARDS

This design, manufacture and performance of AIR FILTERS shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to latest applicable Indian/British/USA standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. The following standards, in particular, shall be applicable for certified ratings of filters and for conducting performance test, if required.

a) BS EN - 779 -Methods of test for air filters used in air conditioning and general ventilation.

3. GENERAL

The enclosed Data sheet A gives the type and other particulars of filters required.

3.1 POLY FIBRE AIR FILTERS

Filtering media shall consist of a suitable fibrous material (e.g. polyethylene extruded sections coir etc.) packed into a 20 gauges GSS framework, complete with handles etc. The filter element shall be supported by galvanised steel wire mesh of 10mm. sq. on either side, Velocity across the filters shall not exceed 2.5 M/sec. Average efficiency Em (%) shall be >/= 80 as per BS EN - 779.

3.2 DRY FABRIC AIR FILTERS

Filter element shall be pressed felt filter fabric or suitable material recommended by the manufacturer, stitched on to galvanised wire gauge support and crimped to form deep folds. Suitable aluminium spacers shall be provided to ensure uniform distribution of air flow through filters. Filter casing shall be provided with neoprene sponge rubber sealing, The filter shall have Average efficiency Em (%) of >/= 95 as per BS EN - 779.

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

Filter shall consist of V-fold galvanised wire mesh interspaced with flat layers of galvanised wire mesh. The density of media shall increase in the direction of air flow. Edges of wire mesh shall be suitably hemmed to prevent abrasion during handling. The media shall be supported on either side by galvanised expanded metal casing. The framework shall be at least 18 gauge GSS. Filter shall be either dry or wetted type as per data sheet=A. The oil shall be mineral oil of approved quality and make. As a the filter frame made of Aluminium alloy conforming to IS:737 can be considered unless use of aluminium is prohibited otherwise due to site conditions being saline/corrosive.

All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance Am (%) shall be >/= 90. However oil wetted air filters shall have Average Efficiency Em (%) >/= 90 as per BS EN - 779..

3.4 AUTOMATIC CLEANING FILTERS

This shall consist of a filter mat and drop eliminator, driven by a suitably rated geared

motor unit being supported on a steel framework. The filter mat shall consist of an endless steel wire mat insets of steel mesh held between an upper & a lower shall drop eliminator shall consist of an endles steel wire without insets of steel mesh. The unit shall include a suitable oil pump, gladge raking mechanism and sludge container and tensioning device. Pressure drop shall be limited to 0.5 / mm WG when clean & 10 mm when dirty. Air velocity across filter shall not exceed 3 M/sec.

3.5 ABSOLUTE FILTERS

Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctyphalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame.

3.6 WATER REPELLANT NYLON FILTERS

This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only.

4. INSPECTION & TESTING

The scope of inspection for air filters shall be as below:

4.1 Dimensional inspection of frame & filter media.

4.2 Witnessing of type tests on one per type per size air filters for the following properties.

a) Gravimetric efficiency.

b) Pressure drop in clean & dirty (choked - %age to be specified) condition.

c) Efficiency as per BS EN - 779.

4.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet).

5. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

5.1 GA Drawing.

5.2 Drawing showing material/construction detail

5.3 Installation and\service manual

5.4 Rating curves/charts

5.5 Test certificates

5.6 Elect. diagrams (when automatic cleaning type)

5.7 Vendor shall also provide soft copy of each drawing in AutoCAD format.

5.8 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

	TITLE	SPECIFICATION NO. PES-571-11000-A-06	
BHEL	**AIR FILTER**	VOLUME II-B	
	DATA SHEET - A	SECTION D	
		REV 00	DATE: JAN 2020
		SHEET 1 OF 1	

DESCRIPTION		**DATA**
1)	**General**	
1.1	Service	: Air Conditioning & Ventilation.
1.2	Location	: Ventilation plant, & Ductable Split AC plant, fresh air fan system. Also for split AC.
1.3	Nos.	: Refer Section 'C' of Specification.
1.4	Total air flow/type	: Refer Section 'C' of Specification.
1.5	Temperature	: As per project information.
1.6	Relative Humidity	: 100%
1.7	Gas Composition	: Atmospheric Air (Dusty) as prevalent in power Station.
1.8	Filter Media	: Synthetic non-woven
1.9	Efficiency filters.	: Average arrestance efficiency of 65-80 % for Dry Panel filter (pre-filters) and average arrestance Efficiency of 80 % down to 20 micron for
1.10	Allowable pressue drop	: 2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters(prefilters). 12 mm in clean condition for fine filters.
1.11	Frame Work	: 18 G, GSS.
1.12	Mounting	: Ladder Type M.S Angles (galvanised)
1.13	Size	: 600 x 600 mm

Note:-

1) Face velocity of air across the filters shall not exceed 2.5 m/sec and for absolute filters velocity shall not exceed 1.5 m/sec.

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 and ventilation system not involving localised exhaust.

2. CODES AND STANDARDS

2.1 The design, construction and performance of complete system shall conform to all currently applicable 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 following standards:-

a) IS: 655 - Specifications for metal air ducts.

b) IS:277 - Specifications for galvanised steel sheets.

c) IS:737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

3. MATERIAL

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

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

3.3 The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest

4. CONSTRUCTION/FABRICATION

4.1 The thickness of sheets, the type of bracing and other fabrication details shall generally conform to requirements given hereunder unless specified otherwise in data sheet A and/or indicated on drawings.

4.2 **RECTANGULAR DUCTS**

4.2.1

S.No.	Max Side	Sheet Thickness		Type of transverse Joint connections	Bracings
		(mm) GI	(mm) Al		
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None

b)	601 to 750	0.63 (24G)	0.80	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles,connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

4.2.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.

4.2.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.

4.2.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:

a) Upto 1000mm - 6 mm dia GI bolts
b) 1001 to 1500 - 8 mm dia GI bolts
c) 1501 and above - 10mm dia GI bolts

4.2.5 The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.

4.2.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.

4.3 **ROUND DUCTS**

4.3.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) Al	
a)	Up to 150	0.63 (24G)	0.80	None
b)	151 to 600	0.80 (22G)	1.00	None
c)	601 to 1000	1.00 (20G)	1.50	40x40x3mm girth MS
d)	1001 to1250	1.00 (20G)	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

4.3.2 The seams on round ducts may be continuously welded or grooved longitudinal seam. In case of welding of GI sheet, zinc rich paint shall be applied on the welded zone.

4.3.3 Round ducts shall either be joined by welding or the ducts shall be swedged 40mm from the ends such that larger end will butt against the swedge and is held in place with sheet metal screws.

4.4 **DUCT SUPPORTS**

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

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

4.5 **FLEXIBLE CONNECTIONS**

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

4.6 **TRANSFORMATIONS AND BREACHES**

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

4.7 **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.

4.8 **EASEMENT**

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

4.9 **ACCESS DOORS**

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

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

4.10 **DAMPERS AND SPLITTERS**

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

4.10.2 FIRE DAMPERS

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

4.10.3 VANES

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

4.10.4 FLASHING

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

4.11 **DIFFUSERS AND GRILLS**

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

Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be

single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

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

4.12 **PLENUMS AND RA BOXING**

All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at 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.

4.13 **ACCOUSTIC LINING**

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

4.14 **PAINTING**

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

4.15 **THERMAL INSULATION**

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

5. INSPECTION AND TESTING

5.1 **INSPECTION & TESTING DURING FABRICATION**

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

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

5.1.3 Check for dimensions & mass as per latest IS-277.

5.1.4 Check for defect, twists, ungalvanised spots as per IS-2629.

5.1.5 Bend test & wrapping test as per IS-277.

5.1.6 Zinc coating test on samples as per IS-6745.

5.2 **INSPECTION & TESTING AT SITE.**

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

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

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**.**

7.4 Installation instruction manual and air balancing manual.

7.5 Duct air leaking test procedure/smoke test procedure.

7.6 Vendor shall also provide soft copy of each drawing in AutoCAD format.

7.7 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

	TITLE	SPECIFICATION NO. PES-571-11000-A-07
BHEL	**LOW PRESSURE AIR DISTRIBUTION SYSTEM**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 / DATE: JAN 2020
		SHEET 1 OF 1

Description	**Data**
1. General (List of areas)	: As per Specification/Tender drawing.
2. GSS Duct Work	
a) Type	: GSS as per IS: 277 (Zinc coating as per Section-C of Specific Technical Requirements.)
b) Size	: As per Section-C of Specific Technical Requirements and bill of quantity.
3. Acoustic lining AC Outlet.	: Up to 5m length from Ductable split
4. Special painting	: Galvanised.
5. Thermal Insulation	: Required in supply air duct in AC entire length.
6. Diffusers (Circular/Square) 300 mm size 350 mm size 450 mm size 550 mm size 600 mm size Any other size	: 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 IS-655
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-C.
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 and 12 M/sec for Ventilation duct. 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

THERMAL INSULATION FOR COLD SURFACES

1. SCOPE

This specification covers design, manufacture, testing at manufacturers works, supply, application & finishing of insulation for cold piping, air conditioning ducting & equipment for low temperature service.

2. CODES & STANDARDS

The design, manufacture and performance of materials covered under this specification shall comply with all currently applicable statues, regulations & safety codes in the locality where the equipment/material are to be installed. The material shall also conform to the latest applicable Indian/British/American codes & standards. Nothing in this specification shall be construed to relieve the vendor of his responsibility. In particular, the material shall conform to the latest editions of the following standards :-

2.1 IS:3069 : Glossary of terms & symbols & units relating to thermal insulation materials.

2.2 IS:4671 : Expanded polystyrene for thermal insulation purposes.

2.3 IS:3677 : Mineral wool for thermal insulation.

2.4 IS:8183 : Resin bonded mineral wool.

3. DESIGN REQUIREMENTS

3.1 The insulating material as well as protective covering shall be new & unused, non-corrosive, vermin/rodent proof and shall be guaranteed to withstand continuously & without deterioration the maximum/minimum temperatures to which they may be subjected to, under specified site conditions.

3.2 The insulation material must be light weight, strong, free from shots & coarse fibre & shall provide high insulation efficiency at low weight & coat. It should be non-hygroscopic & should not rot. It shall not settle or shake down even when subjected to prolonged vibrations.

3.3 The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

4. APPLICATION DETAILS

4.1 The surface to be insulated shall be thoroughly cleaned and allowed to dry. Pressure / hydrostatic tests, if any, shall be carried out before application of insulation.

4.2 A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.

4.3 Hot industrial bitumen of grade 85/40 or 85/25 conforming to latest IS: 702 shall be uniformly applied @ 1.5 kg/sq.m on the surface to be insulated. A similar layer shall also be applied on the inside surface & edges of the insulation. A suitable cold adhesive compound may also be used in place of bitumen.

4.4 Insulation in the form of pipe sections/rolls slabs of specified density & thickness should be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed

with bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.

4.5 In case of double layer application both circumferential & longitudinal joints shall be suitably staggered.

5. VAPOR SEALING & INSULATION FINISH

The insulation shall be treated for vapor sealing & weather proofing & finished as specified in DATA SHEET A The acceptable types of finishes are outlined below:-

5.1 FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH

5.1.1 A thick vapor seal of hot bitumen @ 2.5 kg/Sqm shall be applied on the outer surface of insulation & allowed to dry.

5.1.2 The surface shall then be wrapped with 20mm (3/4"_ hexagonal mesh of 24 SWG GI wire, butting all the joints & laced down with 22 SWG GI lacing wire.

5.1.3 12.5mm (1/2 inch) thick sand cement plaster in the ratio of (1:1) shall be applied in two layers, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.

5.2 FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.

5.2.1 The insulation shall be covered with 500 g polythene/polythene bonded Hessians (PBH) with 50mm overlap on longitudinal & circumferential joints. Overlaps shall be sealed with synthetic adhesive in case o-f polythene & liberal coat of bitumen in case of PBH:

5.2.2 The surface shall then be wrapped with 20mm (3/4") mesh of 24 SWG GI wire butting all the joints & laced down with 22 SWG GI lacing wire.

5.2.3 12.5mm thick (1/2 inch) sand cement plaster in ratio of(4:1) shall be applied in two layers, the second layer being brought to a smooth & even finish similarly as described above.

5.3 FINISH III: EXTERNAL INSULATION WITH SHEET METAL FINISH

5.3.1 The insulation shall be covered with 500g polythene with 50mm overlaps at joints, which shall be sealed with synthetic adhesive or equivalent compound.

5.3.2 The polythene shall be covered with 24 gauge GI/aluminum sheet

5.3.3 25mm wide x 22 SWG GI/aluminum peripheral straps shall be fixed over the GI/aluminum sheet at 300mm centres to secure.

5.4 FINISH IV: EXTERNAL INSULATION WITH PLASTER & WATER PROOFING COMPOUND

For ducts & piping exposed to atmosphere, the finish shall be as follows:

5.4.1 A thick vapor seal of hot bitumen at 2.05 kg/sq.m shall be applied on the outer surface of insulation & allowed to dry.

5.4.2 The surface shall then be wrapped with 20mm (32/4") hexagonal mesh of 24 SWG GI Wire butting all the joints & laced down with 223 SWG GI lacing wire.

5.4.3 12.5mm thick (1/*2 inch) sand cement plaster in ratio of (4:1) shall be applied in two layers, the second layer being brought to a smooth finish with water proofing compound added to the cement.

5.4.4 3 mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fiberglass RP tissue & allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire & finally bitumen paint shall be applied over wire netting.

6. INSULATION OF PUMPS & VALVES

6.1 For all inspection covers & hatches on equipment, pump casing & valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge aluminum sheet metal boxes, which shall be bolted together around the equipment to permit easy removal & replacement. Proper care shall be taken to maintain continuity of vapor seal between the static & removable partitions of the insulation.

6.2 The tenderer may offer thickness of insulation & finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser's approval.

7. INSPECTION & TESTING (REFER SPEC. NO - PES-553.00)

7.1 All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes & standards, shall be carried out at manufacturer's works & test certificates including these for material/accessories shall be furnished for purchasers approval.

8. PAINTING

8.1 Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1 Final version of data sheet 'B' incorporating changes if any along with design data.

9.2 Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following:-

a) Thermal conductivity test.

b) Sound absorption coefficient test.

c) Corrosion test.

d) Sulphur content, moisture content, shot content, moisture absorption etc.

e) Compressive strength & cross breaking strength test.

9.3 Sketches / technical literature / sectional drgs. indicating insulation materials finish and method of application etc.

9.4 Manual dealing with safety aspects & instructions for combating fire arising out of insulation work.

9.5 Instructions on erection and maintenance of insulation work.

9.6 Vendor shall also provide soft copy of each drawing in AutoCAD format.

9.7 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

Insulation Material

Insulation	Code	Thermal Conductivity MW/cm ^{0}C	Density Kg/m^3
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 ^{0}C	At least 24 for duct insulation and 48 for acoustic lining.
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 ^{0}C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 10 ^{0}C	At least 15
Al foiled face Nitrile rubber / XLPE	EN12667	0.037 at 20 ^{0}C	At least 140

Type of Insulation

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded roll Mineral Wool (IS:8183)	Roll/slab	25
		Or AI foiled face Nitrile rubber/XLPE	Roll/slab	25
ii)	Refrigerant Piping	a) Expanded Polystyrene	Pipe Section	75
		or b) Mineral Wool	Pipe Section	75
iii)	AHU drain pipe	a) Expanded Polystyrene	Pipe Section	25
		or b) Mineral Wool	Pipe Section	25
iv)	AHU drain pan coil section and fan section	a) Expanded Polystyrene	Slabs	25
		or b) Mineral Wool	Slabs	25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene	Pipe Section	75
		or b) Mineral Wool	Pipe Section	75
vi)	Chiller	a) Expanded Polystyrene	Slabs	100
		or b) Mineral Wool	Slabs	100
vii)	Chilled Water Pumps	a) Expanded Polystyrene	Slabs	50
		or b) Mineral Wool	Slabs	50
viii)	Expansion tank with pipe	a) Expanded Polystyrene	Slabs/Pipe Section	50
		or b) Mineral Wool	Slabs/Pipe Section	50

Insulation shall be fire retardant class.

SECTION: I

SUB-SECTION: E

LIST OF ANNEXURES

SECTION-I

SUB SECTION E

ANNEXURE-I

LIST OF MAKES-HVAC SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(4X39 MW UJVNL, CHILLA HEP, RMU, HYDRO ELECTRIC PROJECT)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	VAPOUR ABSORBTION MACHINE	VOLTAS / THERMAX
3	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMADENTA
4	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
5	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
6	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRYAIRE(FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
7	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
8	CHILLED & CONDENSER WATER PUMP	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
9	COOLING TOWER	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
10	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP
11	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
13	INSULTATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
14	BALANCING VALVE	ADVANCE
15	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE / ADVANCE
16	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
17	GATE/GLOBE VALVES	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
18	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY /JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
19	MOTORIZED BUTTERFLY VALVE	ANERGY / / BELIMO / JOHNSON / HONEYWELL / SIEMENS
20	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
		PVT LTD / SUNGOV ENGINEERING
21	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
22	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
23	GI SHEETS FOR DUCTING	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL
24	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
25	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
26	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
27	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
28	RELIEF / PURGE VALVE	BRASSOMATIC
29	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
30	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
31	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
32	PRESSURE GAUGE	GENERAL INST CONSORTIUM / BELL / H.GURU INST P. LTD. / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES/ PRECISION MASS PRODUCTS PVT. LTD. / BOSE PANDA INSTT. PVT. LTD.
33	TEMPERATURE GAUGE	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)/ BAUMER TECHNOLOGIES/ GOA THERMOSTATIC/ GAUGE BOURDON/ BUDENBERG GAUGE/ PRECISION MASS PRODUCTS
34	LEVEL GAUGE	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND
35	PRESSURE SWITCH / DP SWITCHES	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT/ KASTURBA UDYOG/ BARKSDALE/ PRECISION MASS PRODUCTS/ MITTAL REFRIGERATION
36	TEMPERATURE SWITCH	INDFOSS/ SEIMENS / DANFOSS/ DK INSTRUMENTS/ SOR INC / VASU / DRESSER / TOSHNIWAL / SWITZER
37	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
38	LEVEL SWITCH	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V ATUOMATE /CHEMTROLS / SIMENS / FLOW STAR / TRAC/ FLOW TECH/ NIVO CONTROLS/ PUNE TECHTROL/ SAPCON/ BAUMER TECHNOLOGIES/ GIC/ SBEM
39	TRANSMITTERS	TAYLOR / ABB/BRISTOL BABCOCK / BIRLA KENT TAYLOR / BLISS ANAND /SBEM/ SMART INST / V AUTOMATION & INST / FISHER-ROSEMOUNT/ SIEMENS/ TATA HONEYWELL/ PUNE TECHTROL/ NIVO CONTROLS/ PANAM ENGINEERS/ EMERSON/ MOORE INDUSTRIES/ TOSHINIWAL INDUSTRIES/ YOKOGAWA/ E&H/ ABB
40	SIGHT FLOW INDICATORS	SIGMA / LEVCON /V AUTOMAT / TELLACE /EUREKA / TATA HONEYWELL/BLISS ANAND/ SCIENTIFIC DEVICES/ BK EQUIPMENTS/ INSTRUMENTATION ENGINEERS
41	FLOW ELEMENT	BRISTOL BABCOCK / BALIGA /LIGHTING EQUIP /ENGINEERING SPECIALITIES /IL / MINCO/ MICRO PRECISION / STAR MECH
42	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM/ PYRO ELECTRIC /WAAREE INSTRUMENTS/ DETRIVE INST & ELECTRONICS / TOSHNIWAL/ GOA INSTRUMENTS/ GAUGE BOURDON/ TECHNO INSTRUMENTS/ TEMPSENS INSTRUMENTS/ THERMAL INSTRUMENTS/ TM TECHNOMATIC/ BAUMER TECHNOLOGIES
43	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA /TRAC / FLOW STAR/ SCIENTIFIC DEVICE
44	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
45	PLC BASED PANEL	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB/ MITSUBISHI ELECTRIC
46	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO
47	PRINTER	HP / CANON / EPSON / XEROX / IBM / LEXMARK
48	UPS	HITACHI-HIREL / APC / DELTA / EMERSON / DB POWER / APLAB
49	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
50	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
51	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
52	METERING PUMP	SHAPO TOOLS / VK PUMPS
53	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
54	PRESSURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
55	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL
56	ROTAMETER	CHEMTROLS SAMIL / EUREKA IND / IL / TRANSDUCERS AND CONTROL

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(4X39 MW UJVNL, CHILLA HEP, RMU, HYDRO ELECTRIC PROJECT)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
57	BATTERY CHARGER	AMARARAJA/ CHHABI ELECTRICAL / DUBAS ENGG. / HBL POWER SYSTEM / STATCON / CALDYNE
58	BATTERY (NI -Cd)	HBL POWER / AMCO SAFT / SAFT
NOTE		
	1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. LIST OF SUB-VENDORS SHALL BE FINALIZED WITH THE FINALLY SELECTED L-1 VENDOR BUT PRIOR TO ORDER FINALIZATION ON L-1 VENDOR BY THE BHEL. 2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER. 3. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3 & C-4 FOR ELECTRICAL AND C&I RELATED EQUIPMENT LIST OF MAKE.	

LIST OF MAKES OF SUB-VENDOR ITEMS

VENTILATION SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLIACBLE
(4X39 MW UJVNL, CHILLA HEP, RMU, HYDRO ELECTRIC PROJECT)

S.No.	Description	Makes
1.	**AIR WASHER & UAF***	HYDERABAD POLUTION CONTROL / SK SYSTEM / ADVANCE VENTILATION / DRAFT AIR / BLUE STAR / VOLTAS / STERLING WILSON & ROOTS COOLING SYSTEM / C.DOCTOR
2.	**AIR HANDLING UNITS**	
3.	**CENTRIFUGAL FAN**	FLAKT / KRUGGER / DRAFT AIR / HYDERABAD POLUTION CONTROL / ADVANCE VENTILATION / PATEL AIR / NICOTRA/ SK SYSTEM / MARATHON / CB DOCTOR / SARLA
4.	**AXIAL FLOW FANS/RE UNITS**	HYDERABAD POLLUTION/ SK SYSTEM / ADVANCE VENTILATION / KRUGER / NICOTRA / MARATHON / FLAKT / CB DOCTOR/ PATEL AIR /SITAL
5.	**FAN**	FLAKT WOODS/ KRUGER/ ANDREW YULE/ AEROTHERM/ DUVENT/ SIWENT (SARLA)/ S.R PRAYAVARAN/ GEC(Alstom)
6.	**CENTRIFUGAL WATER PUMP**	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
7.	**INDUCTION MOTORS (LT)**	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP/ KIRLOSKAR/ G.E.C.
8.	**AIR FILTER**	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER /SPECTRUM / AIR TECH / PUROMATIC/ CHEMFARM/ KIRLOAKAR/ CLEAR AIR PUROFIL/ DYNA
9.	**INSULTATION MATERIAL**	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
10.	**RESIN BOUNDED FIBRE GLASS**	UP TWIGA/ CLYOL/ COOLINE
11.	**FIRE DAMPER**	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
12.	**BUTTERFLY VALVE**	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
13.	**NON RETURN VALVE**	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
14.	**GATE/GLOBE VALVES**	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
15.	**PIPING - ERW**	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
16.	**GI SHEETS FOR DUCTING**	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL/ NIPPON
17.	**HUMID STAT**	JHONSON CONTROL / HONEYWELL / PENN
18.	**GRILLES/ DIFFUSERS**	MOOSA HAJI/ NUTECH/ COSMOS/ OPELLA/ CARYAIRE
19.	**PRESSURE GAUGE**	GENERAL INST CONSORTIUM / BELL / H.GURU INST / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES/PRECISION MASS PRODUCTS/ BOSE PANDA/ FIEBIG/ JAPSIN/ MICA
20.	**THERMOSTATS**	H.GURU/ FIEBIG/ JAPSIN/ MICA/ PENN/ HONEYWELL

VENTILATION SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLIACBLE
(4X39 MW UJVNL, CHILLA HEP, RMU, HYDRO ELECTRIC PROJECT)

21.	**TEMPERATURE GAUGE**	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)/ BAUMER TECHNOLOGIES/ GAUGE BOURDON/ GOA THERMOSTAT/ BUDENBERG GAUGE/ PRECISION MASS PRODUCTS
22.	**LEVEL GAUGE**	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND
23.	**PRESSURE SWITCH / DP SWITCHES**	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT/ KASTURBA UDYOG/ BARKSDALE/ PRECISION MASS/ MITTAL REFRIGERATION
24.	**LEVEL SWITCH**	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V AUTOMAT /CHEMTROLS / SIMENS / FLOW STAR / TRAC/ NIVO CONTROLS/ PUNE TECHTROLS/ SAPCON INSTRUMENTS/ BAUMER TECHNOLOGIES/ GIC
25.	**Y / POT STRAINER**	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING
26.	**CONTROL PANEL**	INDUSTRIAL CONTROL & APPLIANCE/ PYROTECH /POSITRONICS / CONTROL & SWITCHGEAR /SIEMENS / L&T /GE POWER /RITTAL / HOFFMAN
27.	**SWITCHGEAR**	(MCCB, CROMPTON/ SIEMENS/ ABB/ L&T CONTRACTORS ETC.)
28.	**CABLES**	FINOLEX/ NICCO/ UNIVERSAL CABLES/ GRANDLEY/ CCI/ POLYCAB/ FORT GLOSTER
NOTE		
	* Designed by C. Doctor / Blue Star / Voltas / Hyderabad Pollution Controls / SK System /Advance Ventilation / Draft Air / Sterling & Wilson / Roots cooling and fabricated by their approved fabricators.	
	1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. LIST OF SUB-VENDOR SHALL BE FINALIZED WITH THE FINALLY SELECTED L-1 VENDOR BUT PRIOR TO ORDER FINALIZATION ON L-1 VENDOR BY THE BHEL. 2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER. 3. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3 & C-4 FOR ELECTRICAL AND C&I RELATED EQUIPMENT LIST OF MAKE.	

SECTION-I

SUB SECTION -E

ANNEXURE-II

MANDATORY SPARE LIST
(REFER PRICE FORMAT)

SECTION-I

SUB-SECTION-E

ANNEXURE-III

LIST OF TOOLS & TACKLES
AND
LIST OF COMMISSIONING SPARES

LIST OF TOOLS & TACKLES

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

NOTE:-

Above is the minimum list. Any other Tools and tackles required for HVAC system w.r.t. Mechanical, Electrical and C&I part shall also be provided by the vendor as per system / customer requirement without any commercial & Delivery implication to BHEL.

LIST OF COMMISSIONING SPARES

SL NO	ITEM DESCRIPTION	UNIT	QTY
1	FAN BELTS (each type & size)	SET	1
2	PRESSURE GAUGE (for each type and range)	NO.	1
3	TEMPERATURE GAUGE (for each type and range)	NO.	1
4	FILTER (each size)	SET	1
5	COMPRESSOR OIL	Ltr.	1 Lot
6	REFRIGERANT GAS OF EACH TYPE IN A NON-RETURNABLE CYLINDERS	Kg	1 Lot

NOTE:-

Above is the minimum list. Any other commissioning spare required for HVAC system w.r.t. Mechanical, Electrical and C&I part shall also be provided by the vendor as per system / customer requirement without any commercial & Delivery implication to BHEL.

SECTION-I

SUB-SECTION-E

ANNEXURE-IV

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE (REFER SUB SECTION C2B- CUSTOMER SPECS)

SECTION-I

SUB-SECTION-E

ANNEXURE-V

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

S. NO.	BHEL DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
1	PE-V0-464-571-11000-A001**	INSPECTION CATEGORIZATION AND SUBVENDOR LIST FOR HVAC SYSTEM	04
2	PE-V0-464-571-11000-A002	QUALITY PLAN OF CONDENSING UNIT FOR AIR CONDITIONING SYSTEM	16
3	PE-V0-464-571-11000-A003	QUALITY PLAN OF D-X TYPE AHU ALONG WITH CETRIFUGAL FAN	14
4	PE-V0-464-571-11000-A004	QUALITY PLAN OF CENTRIFUGAL BLOWER	14
5	PE-V0-464-571-11000-A005	QUALITY PLAN OF AXIAL FANS	16
6	PE-V0-464-571-11000-A006	QUALITY PLAN FOR LT MOTOR	18
7	PE-V0-464-571-11000-A007	QUALITY PLAN FOR LT SWITCHGEAR	18
8	PE-V0-464-571-11000-A08	QUALITY PLAN FOR PLAN FOR LT CONTROL CABLE	18
9	PE-V0-464-571-11000-A101**	HEAT LOAD CALCULATION FOR AC AREAS OF POWER HOUSE	04
10	PE-V0-464-571-11000-A102**	OPERATION AND CONTROL PHILOSOPHY FOR HVAC SYSTEM	06
11	PE-V0-464-571-11000-A103	VENTILATION FAN SCHEDULE.	24
12	PE-V0-464-571-11000-A104	SPLIT AC SCHEDULE	19
13	PE-V0-464-571-11000-A201	TECHNICAL DATA SHEET & G.A DRAWING OF AIR-COOLED CONDENSING UNIT WITH FOUNDATION DETAILS	19
14	PE-V0-464-571-11000-A202	DATA SHEET & GA FOR D-X TYPE AHU WITH FOUNDATION DETAILS	19
15	PE-V0-464-571-11000-A203	DATA SHEET & GA FOR CENTRIFUGAL BLOWER WITH FOUNDATION DETAILS.	16
16	PE-V0-464-571-11000-A204	DATA SHEET & GA FOR SPLIT AC	16
17	PE-V0-464-571-11000-A205	DATA SHEET & GA FOR AXIAL FANS	16
18	PE-V0-464-571-11000-A206	GA FOR PROPELLAR FANS	16
19	PE-V0-464-571-11000-A207	DATA SHEET FOR INSULATION (THERMAL AND ACCOUSTIC).	16
20	PE-V0-464-571-11000-A208	DATA SHEET & GA FIRE DAMPER WITH ACTUATOR.	14
21	PE-V0-464-571-11000-A209	DATA SHEET OF PIPE.	9
22	PE-V0-464-571-11000-A210	DATA SHEET OF GI AND MS SHEET.	9
23	PE-V0-464-571-11000-A211	DATA SHEET & GA FOR PRE AND FINE FILTERS.	14
24	PE-V0-464-571-11000-A212	DATA SHEET & GA FOR MOTORS (Fan, pumps, Supply and Exhaust axial fans)	19

25	PE-V0-464-571-11000-A213	DATA SHEET FOR INSTRUMENTS (PRESSURE GAUGE, TEMP GAUGE, LEVEL GAUGE, PRESSURE SWITCH, LEVEL SWITCH).	16
26	PE-V0-464-571-11000-A214	DATA SHEET & GA FOR HEATERS	10
27	PE-V0-464-571-11000-A215	TECHNICAL DATA SHEET & G.A. DRAWING OF FRESH AIR AXIAL FAN FOR AIR CONDITIONING SYSTEM	16
28	PE-V0-464-571-11000-A216	TECHNICAL DATA SHEET & G.A. DRAWING OF PAN HUMIDIFIER	12
29	PE-V0-464-571-11000-A217	GA OF AIR TERMINALS LIKE SUPPLY/RETURN AIR DIFFUSER / GRILL / BACK DRAFT DAMPER / INTAKE LOUVER ETC FOR HVAC SYSTEM	18
30	PE-V0-464-571-11000-A501**	PID FOR AC SYSTEM	04
31	PE-V0-464-571-11000-A502**	PID FOR VENTILATION SYSTEM	04
32	PE-V0-464-571-11000-A502**	SCHEME FOR AIR DISTRIBUTION IN TG BUILDING.	10
33	PE-V0-464-571-11000-A503	TYPICAL Details- DUCT FABRICATION DRAWING / SUPPORT / ERECTION. INSULATION OF DUCTING / PIPING & EQUIPMENTS, PIPE ERECTION	10
34	PE-V0-464-571-11000-A504**	AC DUCT LAYOUT FOR CONTROL ROOM ALONGWITH FOUNDATION DETAIL OF AC EQUIPMENT	21
35	PE-V0-464-571-11000-A505**	AC LAYOUT FOR OTHER AC AREAS ALONGWITH FOUNDATION DETAIL OF AC EQUIPMENT	21
36	PE-V0-464-571-11000-A506**	VENTILATION EQUIPMENT & VENTILATION DUCT LAYOUT FOR ALL THE FLOOR FOR POWER HOUSE ALONGWITH FOUNDATION DETAIL OF VENTILATION EQUIPMENT	21
37	PE-V0-464-571-11000-A507	VENT. ARRANGEMENT FOR BATTERY ROOM ALONGWITH FAN FIXING DETAIL.	16
38	PE-V0-464-571-11000-A508	VENT. ARRANGEMENT FOR VARIOUS AUXILIARY BUILDING ALONGWITH FAN FIXING DETAIL.	25
39	PE-V0-464-571-11000-A701	ELECTRICAL PANEL DRAWING INCULDING SLD	25
40	PE-V0-464-571-11000-A702	TDS OF CONTROL PANEL / PLC WITH CONFIGURATION DIAGRAM, BILL OF MATERIAL, GA &INTERNAL WIRING DIAGRAM, LOGIC FLOW DIAGRAM, IO WIRING DIAGRAM, PLC ROOM LAYOUT	22
41	PE-V0-464-571-11000-A703	ELECTRICAL FEEDER LIST.	22
42	PE-V0-464-571-11000-A704	CABLE SCHEDULE	22

43	PE-V0-464-571-11000-A705	TDS FOR POWER AND CONTROL CABLES-TYPE TEST CERTIFICATE FOR CALES, TYPE TEST PROCEDUE, CROSS SECTION	22
44	PE-V0-464-571-11000-A706	TDS AND GA FOR ELECTRICAL PANEL-SCHEME, SLD, BILL OF MATERIAL	22
45	PE-V0-464-571-11000-A707	TDS FOR CABLING-CABLE TRAY, CABLE SUPPORT, TYPE TEST CERTIFICATE, JOINTING KITS, TRIFOIL CLAMPS, ABOVE GROUND EARTHING	25
46	PE-V0-464-571-11000-A708	DRIVE LIST FOR HVAC SYSTEM	20
47	PE-V0-464-571-11000-A709	I/O LIST FOR HVAC SYSTEM	20
48	PE-V0-464-571-11000-A710	LOGIC DRAWING FOR HVAC SYSTEM	20
49	PE-V0-464-571-11000-A711	TECHNICAL DATASHEET & GA, TYPE TEST OF JUNCTION BOX FOR HVAC SYSTEM	20
50	PE-V0-464-571-11000-A712	INSTRUMENT SCHEDULE WITH TAG NUMBER FOR HVAC SYSTEM	24
51	PE-V0-464-571-11000-A713	INTERCONNECTION OF FIELD INSTRUMENTS UPTO JUNCTION BOX FOR HVAC SYSTEM	24
52	PE-V0-464-571-11000-A901	PERFORMANCE / DEMONSTRATION TEST PROCEDURE.	20
53	PE-V0-464-571-11000-A902	O & M MANUAL.	30

BHEL Drawing / Document indicated with ** are basis engineering documents.

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 labelled and included in BOQ / BOM in tabular form.
c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form

indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Drawings/ documents to be submitted for purchasers review/ approval shall be under revision a, b, c… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under r-0, 1, 2, 3 ….etc.

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 (week).

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-VI

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

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

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

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

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

SECTION-I

SUB-SECTION-E

ANNEXURE-VII

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

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

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

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

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

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

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

2. Any damages to equipment / materials.

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

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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

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

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

iii Open storage (O)

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

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

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

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

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

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

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

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

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

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

5. CONCLUSION

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

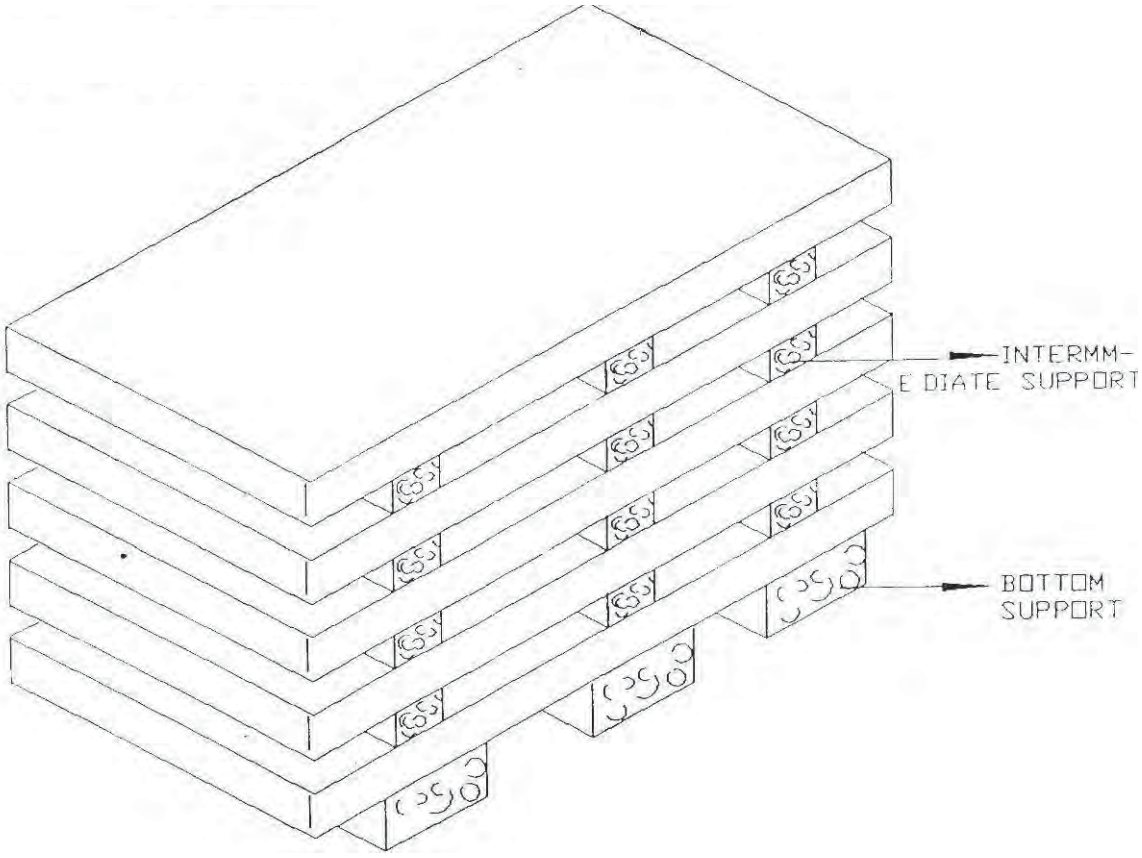


Figure – 1 – PLATE STACKING ARRANGEMENT

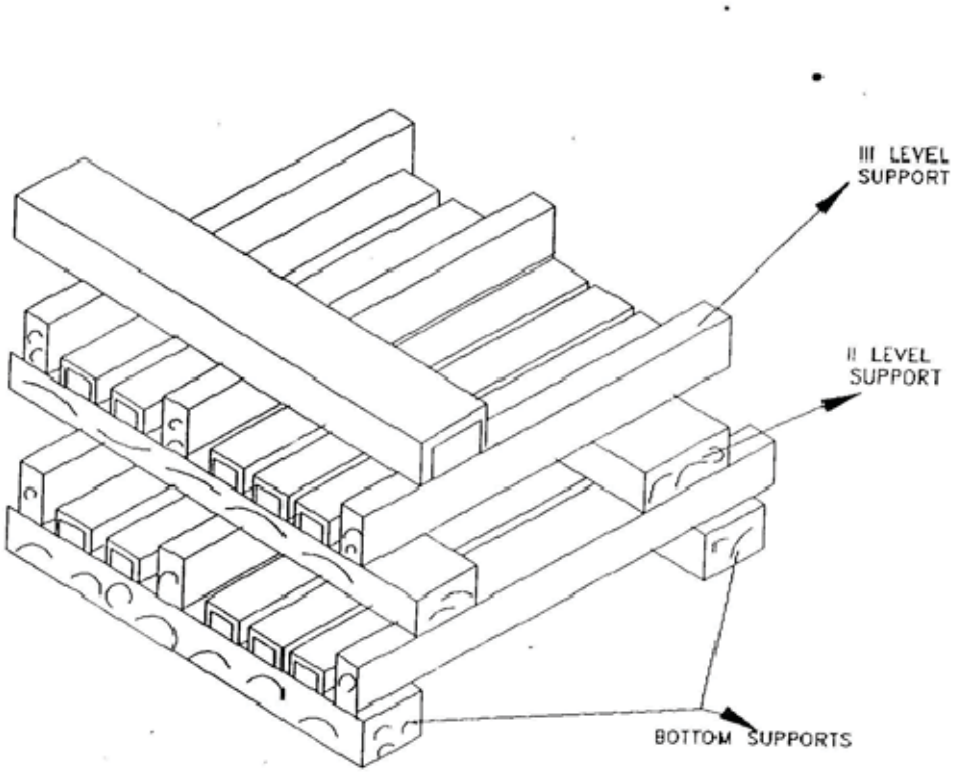


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

SECTION-I

SUB SECTION E

ANNEXURE-VIII

PAINTING SPECIFICATION & COLOUR SCHEME (COVERED UNDER SECTION C2-B)

SECTION-I

SUB SECTION E

ANNEXURE-IX

PACKING PROCEDURE
(COVERED UNDER SECTION C2-B)

SECTION-II

SECTION-II

SUB-SECTION-1

INSPECTION AND TESTING

1.01.00 Inspection and Tests during Manufacture.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1.02.00 Performance Tests at Site

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

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

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

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

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

QAP FORMAT

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT: SYSTEM :

VENDOR : ITEM :

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

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

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

SECTION: II

SUB SECTION: 2

LIST OF DOCUMENTS TO BE SUBMITTED WITH BID

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

1. Compliance cum confirmation certificate
2. Un priced format for HVAC package
    a. Unpriced format for Main package, mandatory spares, tools and tackles and commissioning spares on BHEL e-procurement portal.
3. Deviation schedule /No deviation certificate in attached format ‘Deviation sheet (Cost of withdrawal)’.
4. Pre-bid clarification schedule and signed copy of technical corrigenda, if any.

SECTION: II

SUB SECTION: 3

COMPLIANCE CUM CONFIRMATION CERTIFICATE

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SECTION: II

SUB SECTION: 4

PRE-BID CLARIFICATION SCHEDULE

PRE-BID CLARIFICATION SCHEDULE

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

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

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

SECTION: II

SUB SECTION: 5

NO DEVIATION CERTIFICATE
(REFER ANNEXURE-II OF GCC REV 07)

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

NOTES:

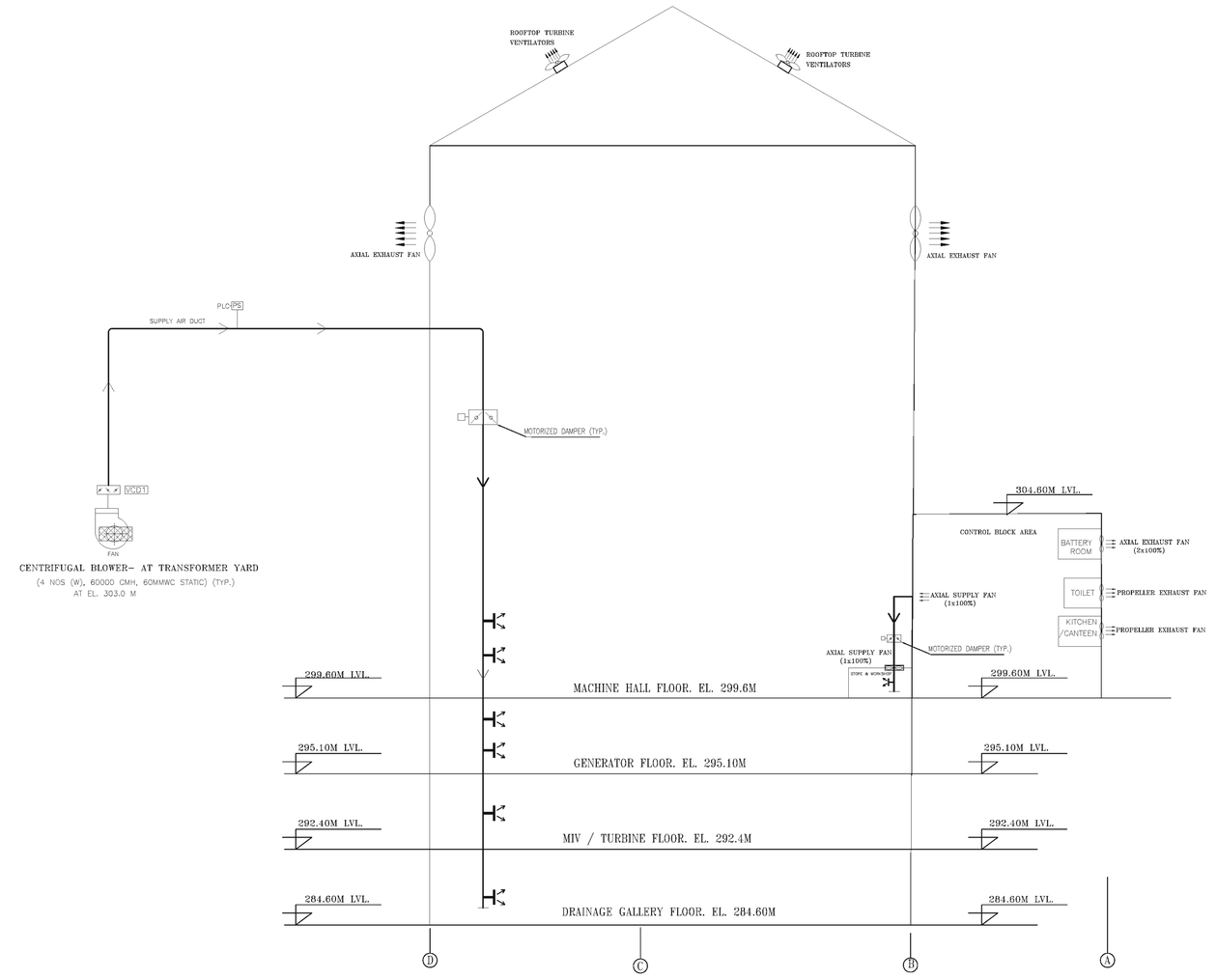
1. Cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. All the bidders have to list out all of their Technical & Commercial Deviations (if any) in detail in the above format.
3. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
4. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable. In absence of same, such deviation (s) shall not be considered and offer shall be considered in total compliance to NIT.
5. Bidder shall furnish price copy of above format along with price bid.
6. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
7. Bidders to note that any deviation (technical / commercial) not listed in above and asked after Part I opening shall not be considered.
8. For deviations w.r.t. Credit period, Liquidated damages, Firm prices if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VII of GCC, Rev-07 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
9. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not

be considered.
10. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
11. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
12. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
13. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.
14. In case of NIL deviation, write "NIL" for both tech and commercial deviation and submit along with part-1.

SECTION: II

SUB SECTION: 6

TENDER DRAWINGS



POWER HOUSE

LEGEND :-

TT	TEMPERATURE TRANSMITTER
PT	PRESSURE TRANSMITTER
PS	PRESSURE SWITCH
	DUCT
	FIRE DAMPER(M)
	PRE FILTER
VCD	VOLUME CONTROLDAMPER
MD	MOTORIZED DAMPER
	AXIAL FAN
	WIND DRIVEN TURBINE

NOTES :-

1 ALL EQUIPMENT DRAIN SHALL BE CONNECTED TO NEAREST BUILDING/ PLANT ROOM DRAIN (BY HVAC SUPPLIER)

2 MOTORIZED DAMPERS SHALL BE PROVIDED IN THE DUCT WHERE IT WILL CROSS THE WALL/FLOOR. FURTHER IN BRANCH DUCT, VOLUME CONTROL DAMPER SHALL BE PROVIDED

3 THE INSTRUMENTATION & CONTROL / MONITORING SHALL BE FINALIZED DURING DETAILED ENGINEERING.

4 DRAIN & VENT VALVE SHALL BE PROVIDED AS PER LAYOUT REQUIREMENT.

5 VENTILATION DUCT RUNNING OUTSIDE THE BUILDING SHALL BE INSULATED AS PER SPECIFICATION.

6 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH OTHER REQUIREMENTS MENTIONED IN SPECIFICATION.

7 CENTRIFUGAL EXHAUST FAN SHALL BE PROVIDED FOR VENTILATION OF TURBINE PIT ALONG WITH DUCTING. EXHAUST FAN SHALL BE KEPT OUTSIDE TURBINE PIT ALONG WITH DUCTING (IF REQUIRED). EXHAUST FAN SHALL BE KEPT OUTSIDE THE TURBINE PIT.

8 MOTOR EXPOSED SHALL BE PROVIDED WITH CANOPY FOR RAIN PROTECTION.

FOR TENDER PURPOSE ONLY

REV	DATE	ALTERED / CHECKED / APPROVED

ADDITIONAL INFORMATION

STATUS OF DRAWING
TENDER STAGE
DISTRIBUTION OF PRINTS

NAME OF PROJECT: CHILLA HEP R&M

NAME OF CUSTOMER: M/S. UJVN LIMITED

BHARAT HEAVY ELECTRICALS LTD. BHOPAL

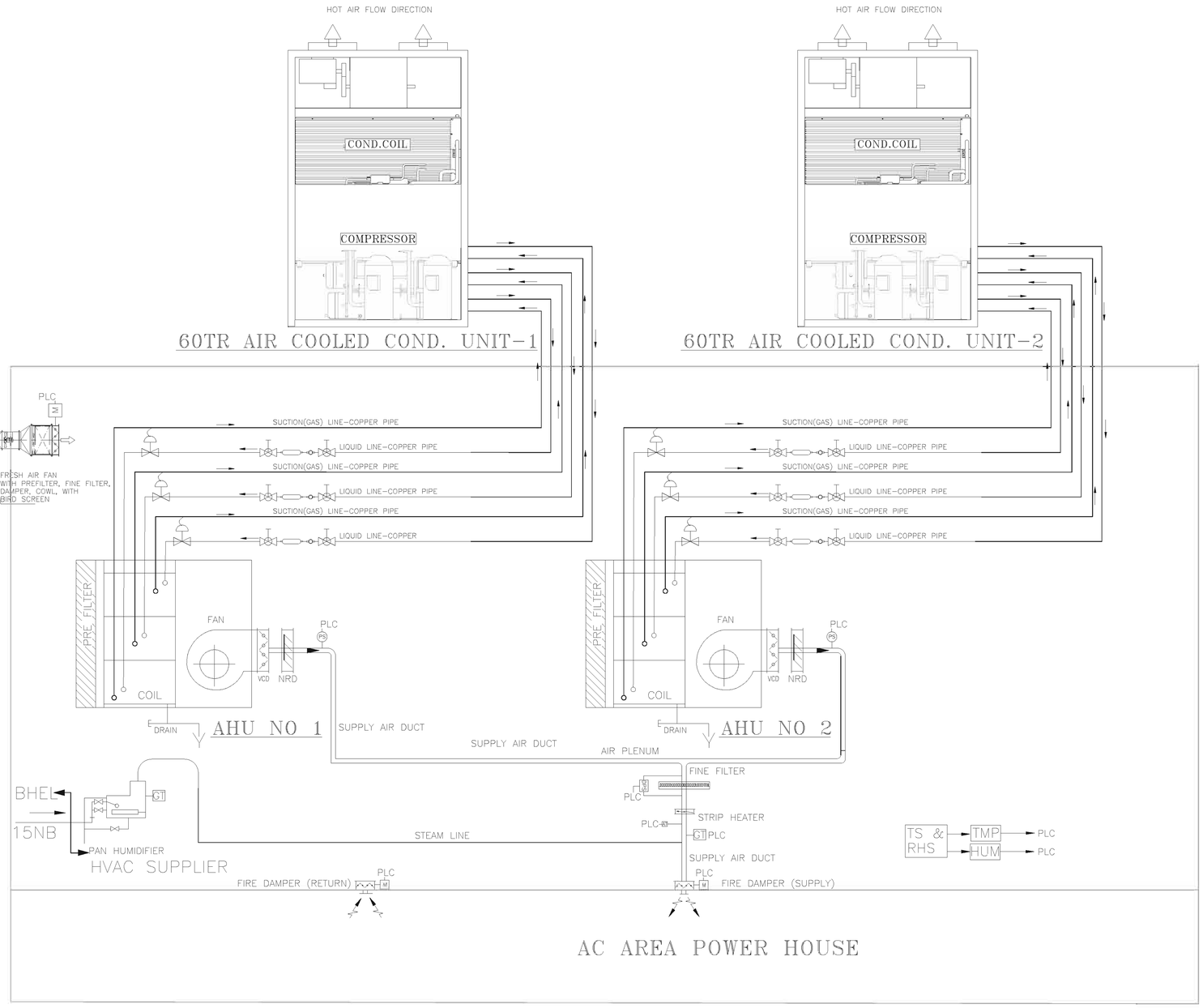
	NAME	SIGN.	DATE	NO. OF VAR.
DRN	AK	-sd-	01.05.25	
CKD	LJ	-sd-	01.05.25	
APPD	GB	-sd-	01.05.25	

DEPT / CODE | UNTOL. DIMS. GR. | SCALE 1:103

TITLE: P&ID FOR VENTILATION SYSTEM FOR POWER HOUSE

DRAWING NO. PE-DG-464-571-11000-A001 | REV 00

SHT NO. 01 | NO. OF SHT. 01



P&ID DIAGRAM FOR A/C SYSTEM FOR POWER HOUSE CONTROL ROOMS

LEGENDS

SUCTION LINE

LIQUID LINE

STEAM LINE

MAKE UP WATER LINE

LEGENDS & BILL OF QUANTITY

LEGEND	DESCRIPTION	SIZE	QTY.
	BALL VALVE	–	12 NOS.
	LIQUID DRYER	–	6 NOS.
	EXPANSION VALVE	–	6 NOS.
	LIQUID INDICATOR	–	6 NOS.
AT—PLC	AIRSTAT	–	1 NO.
GT—PLC	GYSERSTAT	–	1 NO.
PLC—TS & RHS—TS RH	TEMP. CUM RH SENSOR	–	1 NO.
DPS	DIFFERENTIAL PRESSURE SWITCH	–	1 NOS.
PS	PRESSURE SWITCH	–	2 NOS.
M	MOTORIZED FIRE DAMPER	–	2 NOS.
	FINE FILTER	–	LOT
	VOLUME CONTROL DAMPER	–	2 NOS.
	PRE FILTER	–	LOT
	STRIP HEATER	–	–
NRD	NON RETURN DAMPER	–	2 NOS.

TYPICAL SPECIFICATION OF AIR COOLED CONDENSING UNIT

QUANTITY	2 NOS (1 WORKING + 1 STANDBY)
RATED CAPACITY	50 TR

TYPICAL SPECIFICATION OF AIR HANDLING UNIT

QUANTITY	2 NOS (1 WORKING + 1 STANDBY)
RATED CAPACITY	AS PER REQUIREMENT

NOTES

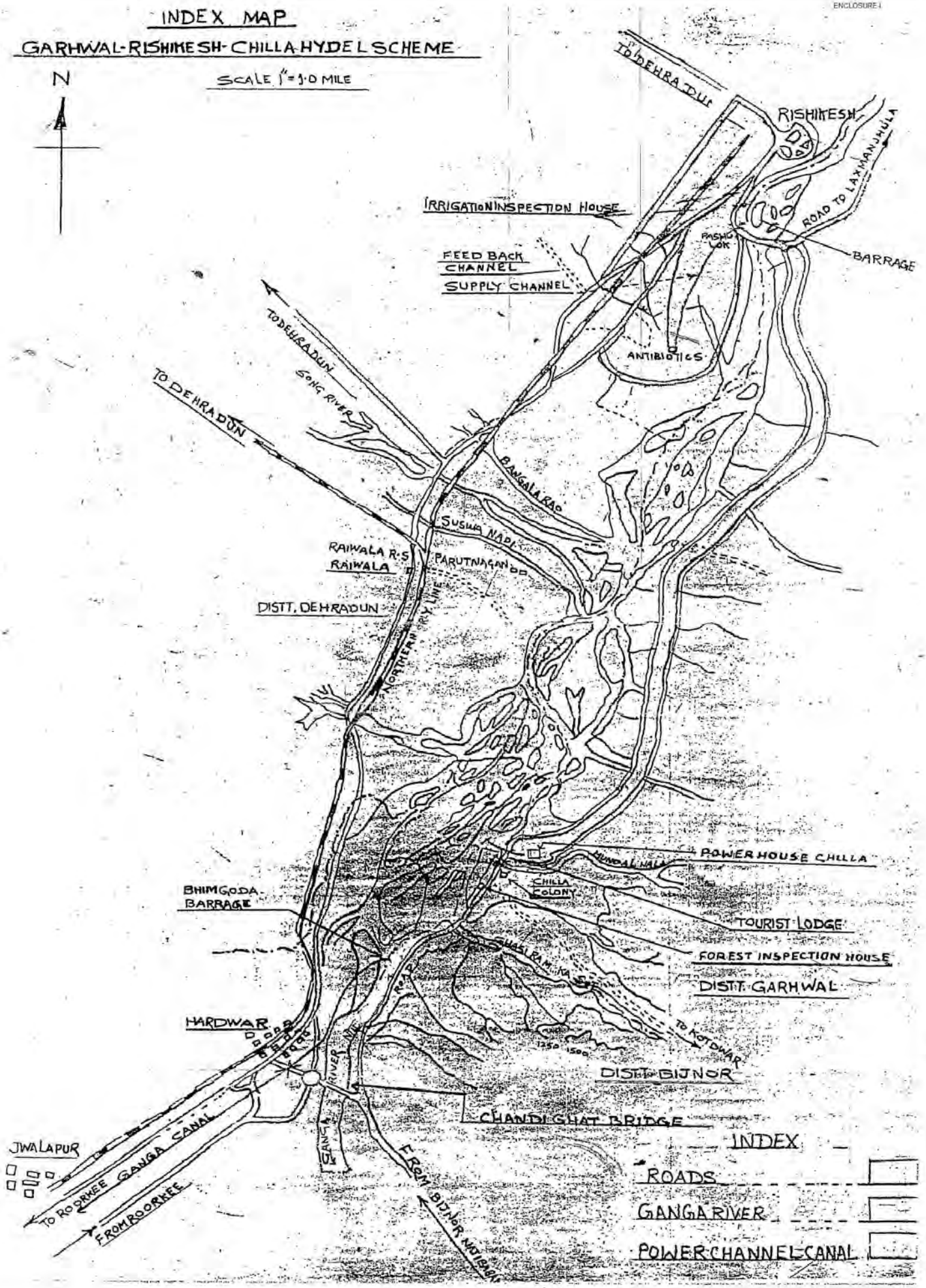
1. COMPRESSORS QTY FOR DX UNIT AS PER OEM.
2. ALL EQUIPMENT DRAIN SHALL BE CONNECTED TO NEAREST BUILDING/ PLANT ROOM DRAIN (BY HVAC SUPPLIER).
3. & CLARIFIED WATER SHALL BE PROVIDED BY BHEL AT TERMINAL POINT AND FURTHER CONNECTION TO PAN HUMIDIFIER WITH PIPING VALVE SHALL BE DONE BY HVAC SUPPLIER.
4. ALL PIPES, SUCTION AND LIQUID LINE INSULATION SHALL BE AS PER TECHNICAL SPECIFICATION.
5. ALL INSTRUMENT AND TEST POINT SHALL BE PROVIDED WITH ISOLATING ROOT VALVE.
6. TEMP. SENSOR (TS) ALONG WITH TEMP. TRANSMITTERS & RELATIVE HUMIDITY SENSOR (RHS) SHALL BE PROVIDED IN AHU ROOM.
7. AIR RELEASE VALVE SHALL BE PROVIDED AS PER SYSTEM REQUIREMENT AT SUITABLE LOCATION.
8. FIRE SIGNAL SHALL TRIP/SHUT–DOWN AHU AND FRESH AIR FAN BESIDES CLOSURE OF MOTORISED FIRE DAMPER.
9. ALL INSULATION SHALL BE PROVIDED AS PER TECHNICAL SPECIFICATIONS
10. SUPPLY AND RETURN AIR DUCT SHALL BE PROVIDED WITH AUTOMATIC (MOTORISED) FIRE DAMPER AT LOCATIONS WHERE DUCTS PASS THROUGH WALLS & FLOOR. OPERATION OF THESE DAMPER SHALL BE INTERLOCKED WITH THE FIRE ALARM SYSTEM AND SHALL ALSO BE POSSIBLE TO OPERATE MANUALLY FROM THE REMOTE CONTROL PANEL. BRANCH DUCT, VOLUME CONTROL DAMPER SHALL BE PROVIDED

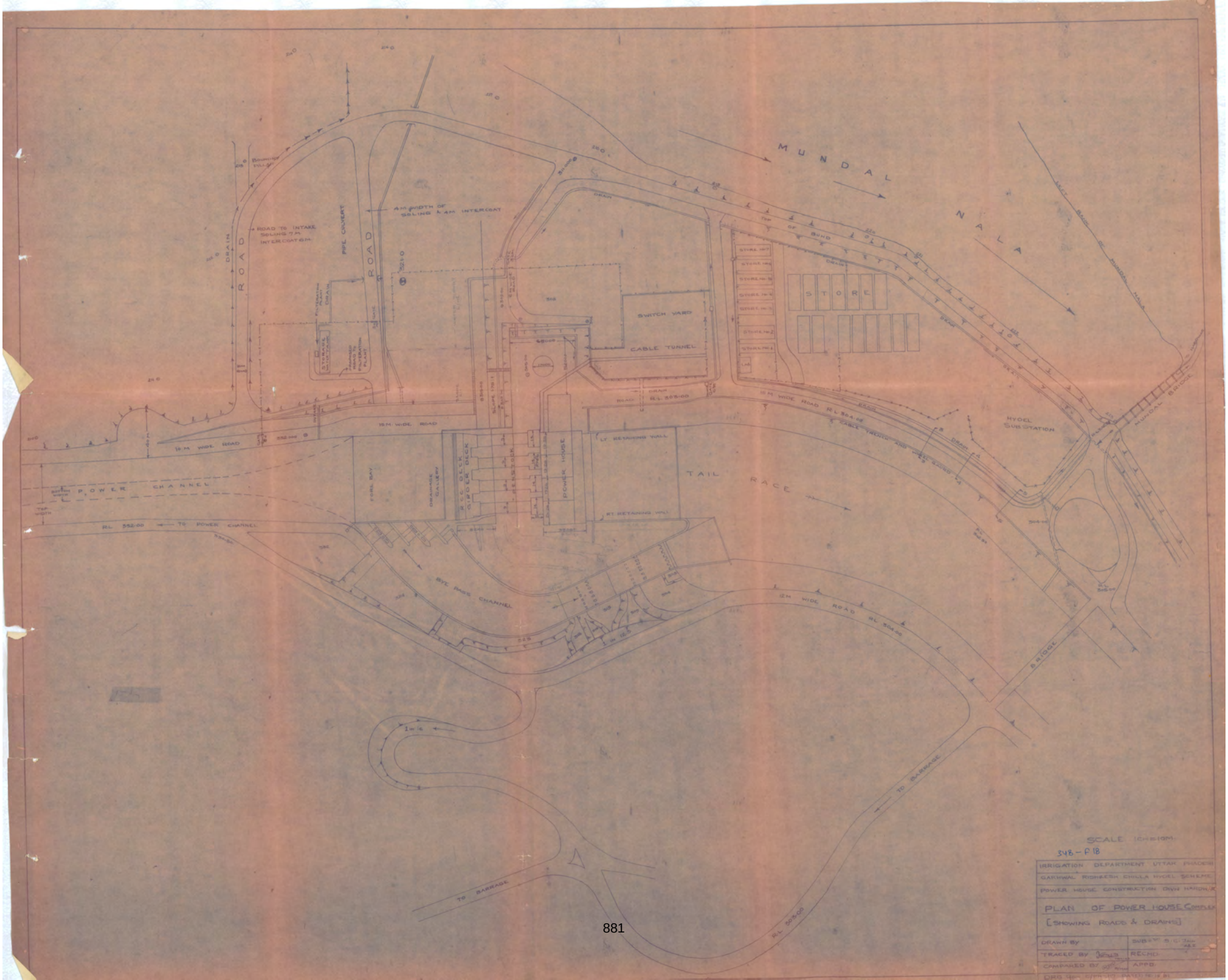
REV	DATE	ALTERED / CHECKED / APPROVED

ADDITIONAL INFORMATION		
STATUS OF DRAWING	TENDER STAGE	
DISTRIBUTION OF PRINTS		
NAME OF PROJECT	CHILLA HEP R&M	
NAME OF CUSTOMER	M/S. UJVN LIMITED	
BHARAT HEAVY ELECTRICALS LTD. BHOPAL		

	NAME	SIGN.	DATE	NO. OF VAR.
DRN	AK	-sd-	01.05.25	
CKD	LJ	-sd-	01.05.25	
APPD	GB	-sd-	01.05.25	

DEPT / CODE	UNTOL. DIMS. GR.	SCALE	1:103
TITLE	P&ID FOR D-X TYPE CONDENSING UNIT FOR AC SYSTEM FOR POWER HOUSE	DRAWING NO.	PE-DG-464-571-11000-A002
		REV	00
		SHT NO. 01	NO. OF SHT. 01


INDEX MAP
GARHWAL-RISHIKESH-CHILLA HYDEL SCHEME
N
SCALE 1"=1.0 MILE
TO DEHRA DUN
RISHIKESH
ROAD TO LAXMANJHULA
IRRIGATION INSPECTION HOUSE
FEED BACK CHANNEL
SUPPLY CHANNEL
BARRAGE
TO DEHRADUN
SONG RIVER
TO DEHRADUN
BANGALA RAO
SUSUWA NADI
RAIWALA R.S
RAIWALA
PARUTNAGAR
DISTT. DEHRADUN
NORTHERN RLY. LINE
POWER HOUSE CHILLA
CHILLA COLONY
TOURIST LODGE
FOREST INSPECTION HOUSE
DISTT. GARHWAL
BHIMGODA BARRAGE
HARDWAR
TO KOTDWAR
DISTT. BIJNOR
CHANDI GHAT BRIDGE
JWALAPUR
TO ROORKEE GANGA CANAL
FROM ROORKEE
FROM BIJNOR NAJIBABAD
INDEX
ROADS
GANGA RIVER
POWER CHANNEL-CANAL


MUNDAL NALA
ROAD
DRAIN
ROAD TO INTAKE
PIPE CULVERT
4m WIDTH OF SOLING & 4m INTERCOAT
SWITCH YARD
CABLE TUNNEL
STORE
18M WIDE ROAD
POWER CHANNEL
POWER HOUSE
TAIL RACE
HYDEL SUBSTATION
MUNDAL BRIDGE
BYE PASS CHANNEL
12M WIDE ROAD
BRIDGE
TO BARRAGE
SCALE 1CM=10M
348-P18
IRRIGATION DEPARTMENT UTTAR PRADESH
GARHWAL RISHIKESH CHILLA HYDEL SCHEME
POWER HOUSE CONSTRUCTION DIVN HARIDWAR
PLAN OF POWER HOUSE COMPLEX
[SHOWING ROADS & DRAINS]
DRAWN BY
TRACED BY
COMPARED BY
SUBMD.
RECMD.
APPD.