



Technical specification for
CONTROL & INSTRUMENTATION
4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

SHEET

OF

PLC Quality Plan

PEM :: C&I		STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER										QUALITY PLAN NO.: PE-QP-999-145-1036			
												VOLUME IIB		SECTION D	
												REV. NO. 01		DATE: 24.08.2007	
												SHEET 1		OF 8	
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			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				

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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									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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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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	MI	- Minor characteristics	V	V	- Agency Verifying the Test.	3	- Sub-vendor

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									P	W	V						

3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/Electrical	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/Desktop Verification	Operation of PLC driven annunciator 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	

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**STANDARD QUALITY PLAN
FOR
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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

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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

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6. Control Panel /Desk Verification

- PLC driven annunciation system should be checked by alarm signal simulation.
- Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

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

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

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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.



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OF

ACTUATOR SPECIFICATION

VOLUME: V-A

SECTION-III

TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS

1.00.00 **SCOPE**

- 1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves/dampers.
- 1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. All the electrical actuators shall be INTEGRAL type only.

2.00.00 **STANDARDS**

- 2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed
- i) IS -9334
- ii) IS-325

3.00.00 **SERVICE CONDITIONS**

- 3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.
- 3.03.00 For actuator motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 **RATING**

- 4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.
- 4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

- 5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.
- 5.02.00 Attain full speed operation before valve load is encountered and imparts an unseating blow to start the valve in motion (hammer blow effect).
- 5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
- 5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
- 5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

- 6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring.
- 6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy. Degree of protection of enclosure for motor actuator shall be IP-65.
- 6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 **Motor**

- 6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.
- 6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.
- 6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.
- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be with integral starter with 3phase/3wire, 415V AC and operable from remote.

- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall de-energize automatically when the motor is energized.
- 6.05.00 **Position Indicator/Transmitter**
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, 4-20 mA current signal as position feedback, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. All wiring shall be done with 1100 V grade fire resistance PVC insulated stranded copper conductor of not less than 2.5 Sq.mm cross section. All wiring shall be identified at both ends with ferrules. All the electrical actuators shall have uniform wiring.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.
- 7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V control transformer with primary & secondary fuses.

8.00.00 **TEST**

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 **DRAWINGS, DATA & MANUALS**

- 9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **To be submitted with Bid**

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues. Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, BOM, control & schematics, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A : Technical Specifications for Electrical Equipment & Accessories.

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

S	upply	Description	Consumer
	L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz Effectively earthed	u Motors above 0.2kW pto less than 175kW.
		Fault level 50 kA symm. for 1 sec.	
	(ii)	240V AC/415V AC	Motors upto 0.2kW.
		240V, 1Ø, 2W, 50 Hz effectively earthed	o Lighting, Space heat- ing , A.C supply for Contr- l & protective devices.
	D.C. Supply	220V, 2W, unearthed	& D.C. alarm, control protective devices
		Fault level 25* kA. for 1 sec.	

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

A.C. Supply :

V	oltage	:	± 10%
	Frequency	:	+3% to -5%.
	Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242
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OF

Actuator Data Sheet



SPECIFICATION FOR MOTORISED VALVE ACTUATOR

SPECIFICATION NO.: PE-SS-411-145-I007

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DATE: 14.11.14

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)

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GENERAL*	* PROJECT	4X270 MW BHADRADRI TPS	
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	☒ ON / OFF REQUIRED	☒ INCHING (AS REQUIRED)
	* 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	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(REGULATING) SERVICE 150 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.	
	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	
	COLOUR SHADE	☒ BLUE (RAL 5012) ENAMEL ☐	
	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 INTERNALLY	
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 65 ☒ IP 67 ☐ FLAME PROOF ☐ IP 55, TOTALLY ENCL, SELF VENTILATED.	
	@ INSULATION CLASS	☐ CLASS-B ☒ CLASS-F (TEMP. RISE LIMITED TO CLASS B)	
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☐	



SPECIFICATION FOR MOTORISED VALVE ACTUATOR

SPECIFICATION NO.: PE-SS-411-145-I007

VOLUME

SECTION

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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)

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	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)		
	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 (Applicable for integral Starter)	INTERPOSING RELAYS	REQUIRED		
	INTERPOSING RELAY (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	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	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-411-145-I007

VOLUME

SECTION

REV. NO. 00

DATE: 14.11.14

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)

350

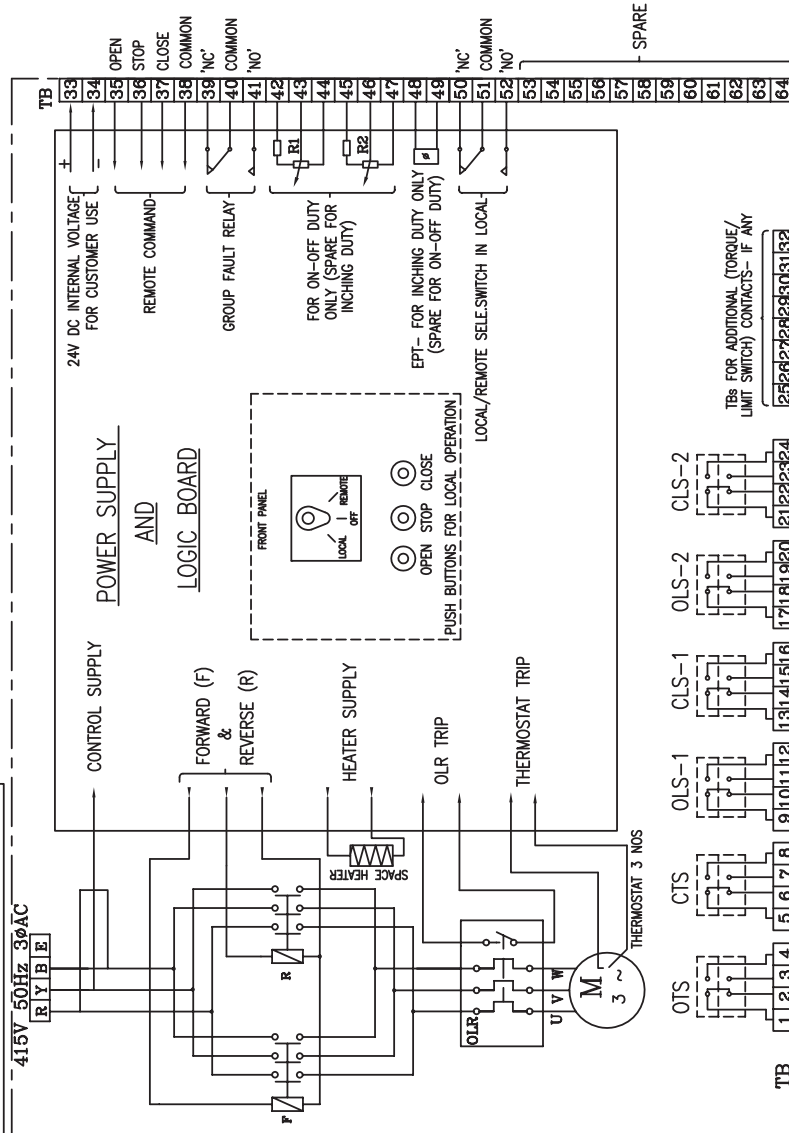
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty)	☒ REQUIRED ☐ NOT REQUIRED		
	MFR & MODEL NO.	BIDDER TO SPECIFY		
	TYPE	☒ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS		
	SUPPLY	☒ 24V DC ☐		
	OUTPUT	☒ 4-20mA		
	ACCURACY	± 1% FS		
SPACE HEATER	@SPACE HEATER	REQUIRED		
	@ POWER SUPPLY			
	@ RATING	415v, 3PH, AC FOR RATING > 0.2KW; SINGLE PHASE FOR RATING < 0.2KW		
TERMINAL BOX	MOTOR TERMINAL BOX	REQUIRED		
	ACTUATOR TERMINAL BOX	REQUIRED		
	ENCL CLASS MTR T.B. / ACTUATOR T.B.	@ ☒ IP 67 @ ☐	☒ IP67 ☐	
	@ 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:--DURING DETAIL ENGINEERING		
	@ SPACE HEATER CABLE GLAND	SIZE: 2C x 2.5 sq. mm		
	OTHER CONTROL CABLE GLANDS-1	INSTRUMENT CABLE SIZE FOR ON/OFF DUTY VALVES SHALL BE 8PX0.5 SQMM - ONE CABLE GLAND OF OD SIZE 20 MM. INSTRUMENT CABLE SIZE FOR INCHING DUTY TYPE VALVES SHALL HAVE TWO NO. CABLES (ONE NO. 8PX0.5 SQMM AND 2ND 2PX0.5 SQMM) - TWO NO. GLANDS OF OD SIZES 20 MM & 15 MM.		
	OTHER CONTROL CABLE GLANDS-2			
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.

NOTES:

- SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
- CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL 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
- TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
- CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
- 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.
- 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%.
- THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

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

DRAWING NO. 3-V-MISC-24227



SWITCH TERMINALS FOR CUSTOMER USE

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 TRANSMITTER (Contactless , 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

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	OPEN
	11-12	STOP
CLS-1	13-14	CLOSE
	15-16	COMMON
OLS-2	17-18	OPEN
	19-20	STOP
CLS-2	21-22	CLOSE
	23-24	COMMON
SWITCH NO.	TERMINAL NO.	INTERMEDIATE POSITION
	a	b
FULL OPEN	FULL CLOSE	FULL CLOSE

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)					

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



BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TRUCHIRAPALLI-620014.

DEPT VL

CODE

SCALE

WEIGHT (KG)

REFERENCE INFORMATION

NO. OF

VAR

REV DATE

ALTERED

CHD & APPD

WIRING DIAGRAM (TERMINAL PLAN)

FOR ACTUATOR WITH INTEGRAL STARTER

U 01

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

DRAWING NO. 3-V-MISC-24227

REV 0

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Size A3



Technical specification for
CONTROL & INSTRUMENTATION
 4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

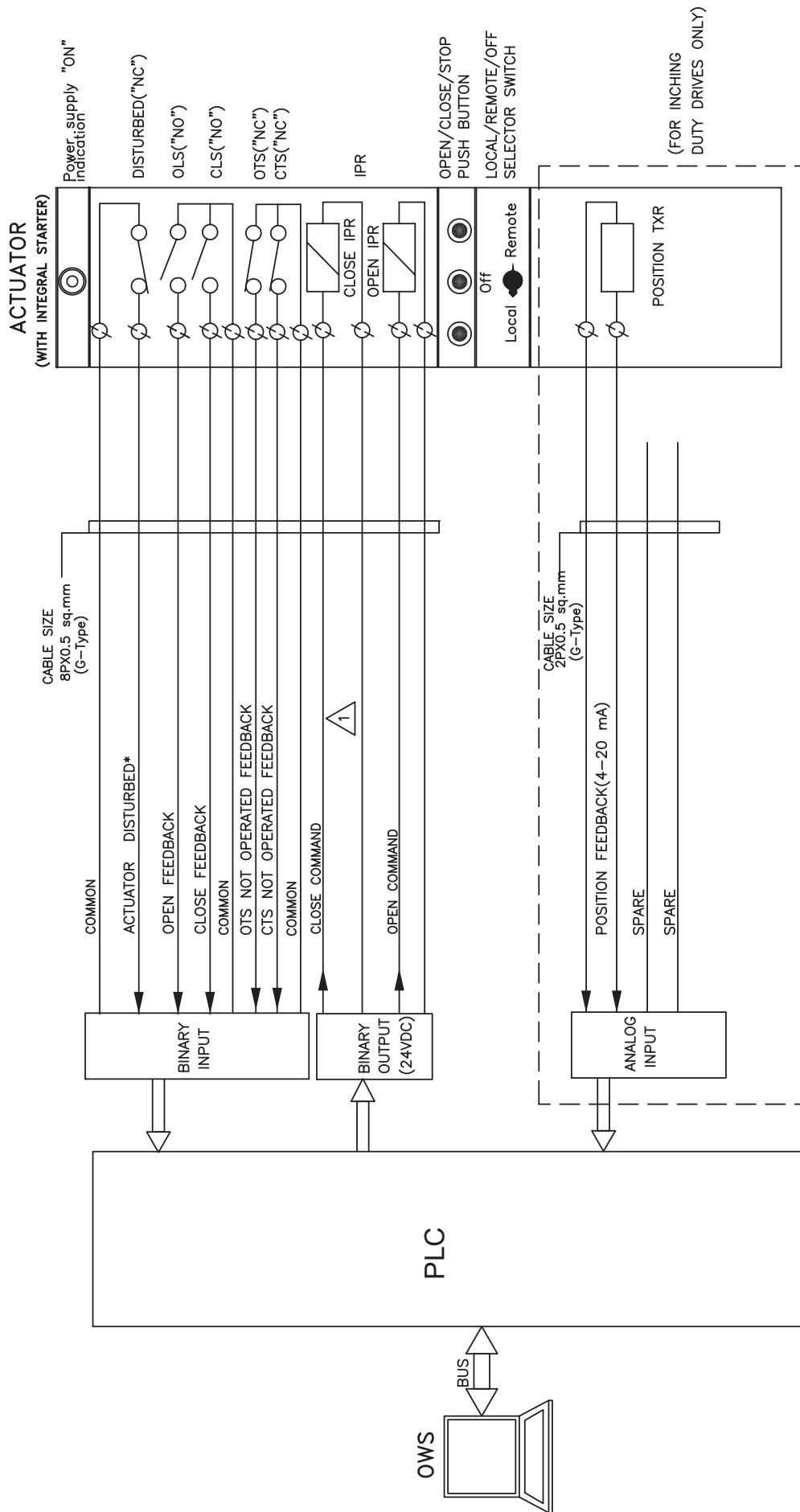
DATE : 19.03.2015

SHEET

OF

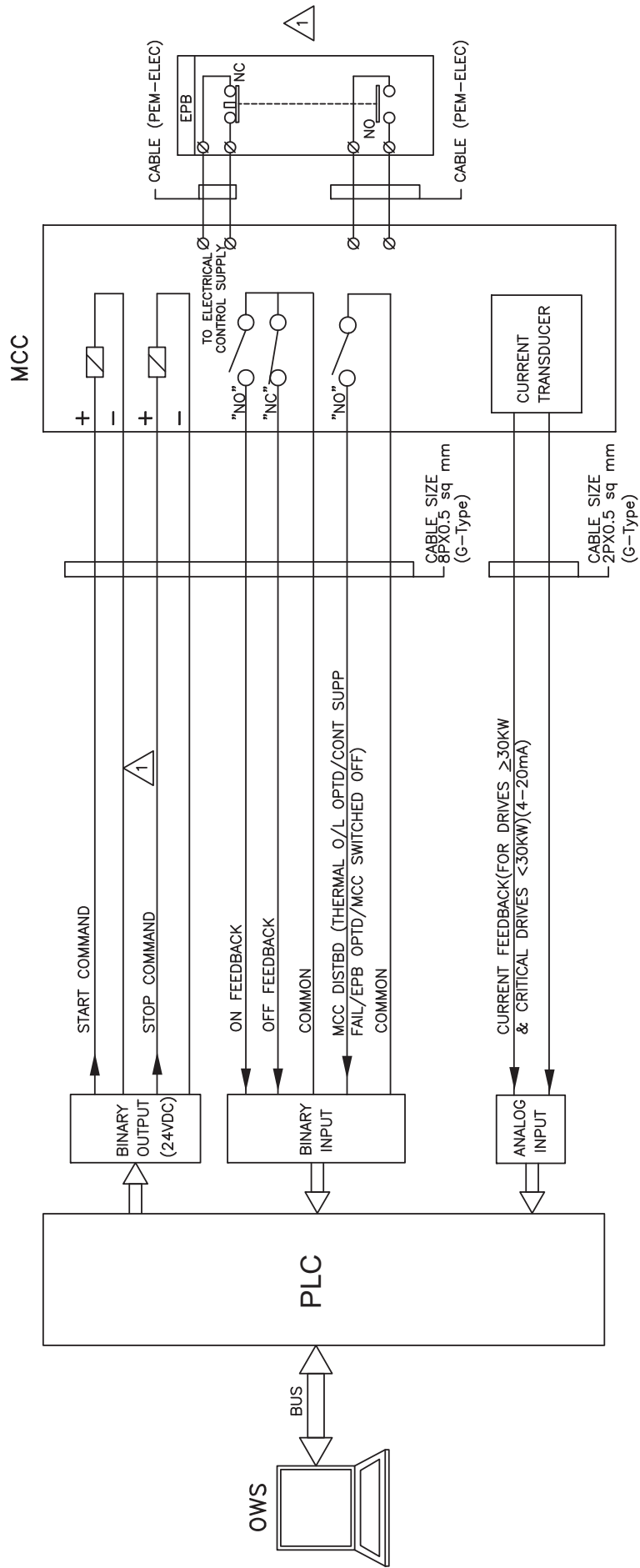
Drive Control Philosophy

PLC INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



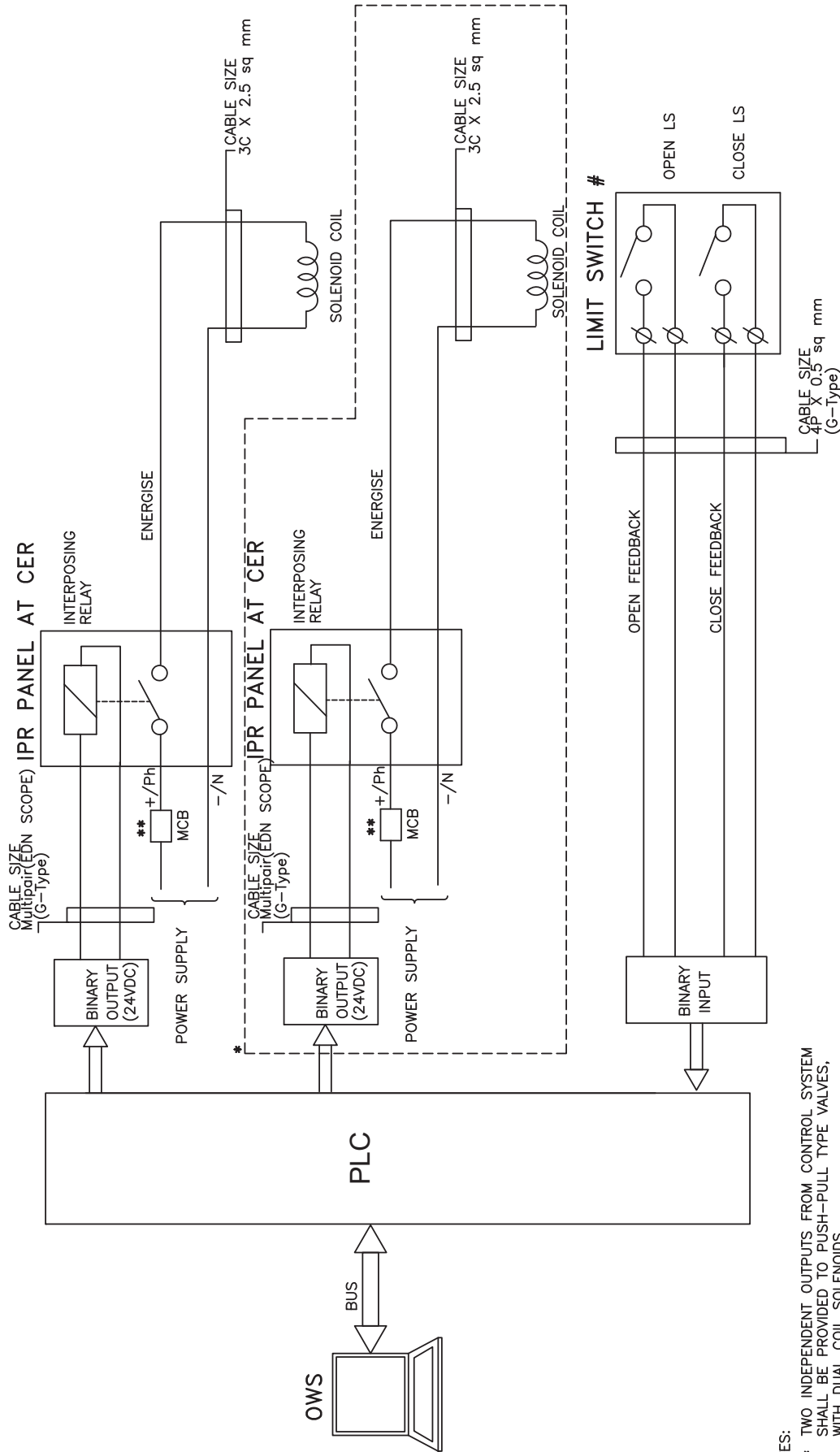
PROJECT: 4 X 270 MW BHADRADRI TPS		DRG.NO.	PE-DM-411-145-1002
TITLE		DATE	06.02.2015
PLC INTERFACE FOR BIDIRECTIONAL DRIVE		REV.NO.	01
		SHT	7 OF 130

PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE



	PROJECT: 4 X 270 MW BHADRADRI TPS		DRG.NO.: PE-DM-411-145-1002
	TITLE		DATE 06.02.2015
	PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE		REV.NO. 01
			SHT 8 OF 130

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.



PROJECT: 4 X 270 MW BHADRADRI TPS

TITLE PLC INTERFACE FOR SOLENOID DRIVE

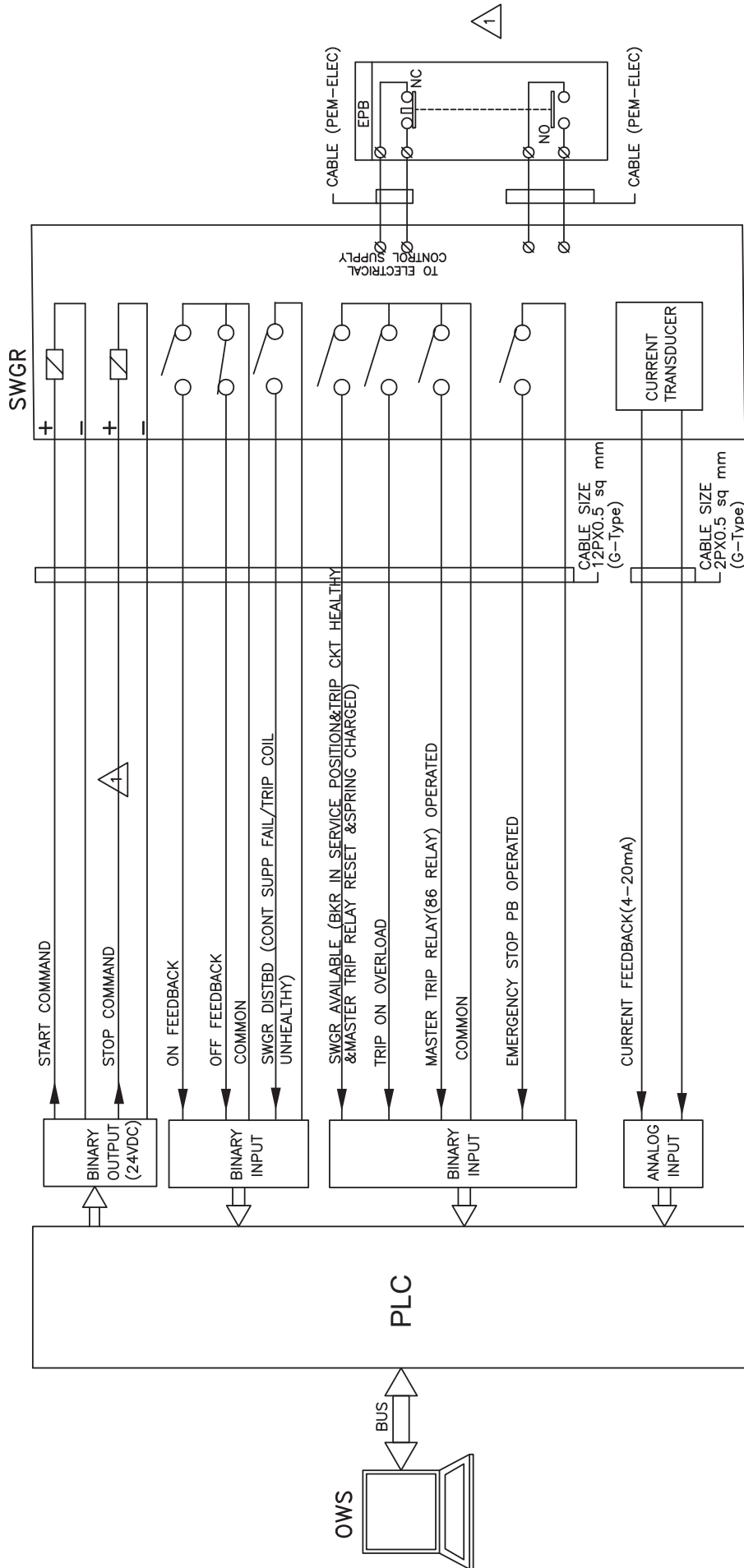
DRG.NO. PE-DM-411-145-1002

DATE 18.11.2014

REV.NO. 00

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page no. 48 of 130

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



PROJECT: 4 X 270 MW BHADRADRI TPS

TITLE
PLC INTERFACE FOR
UNIDIRECTIONAL HT DRIVE

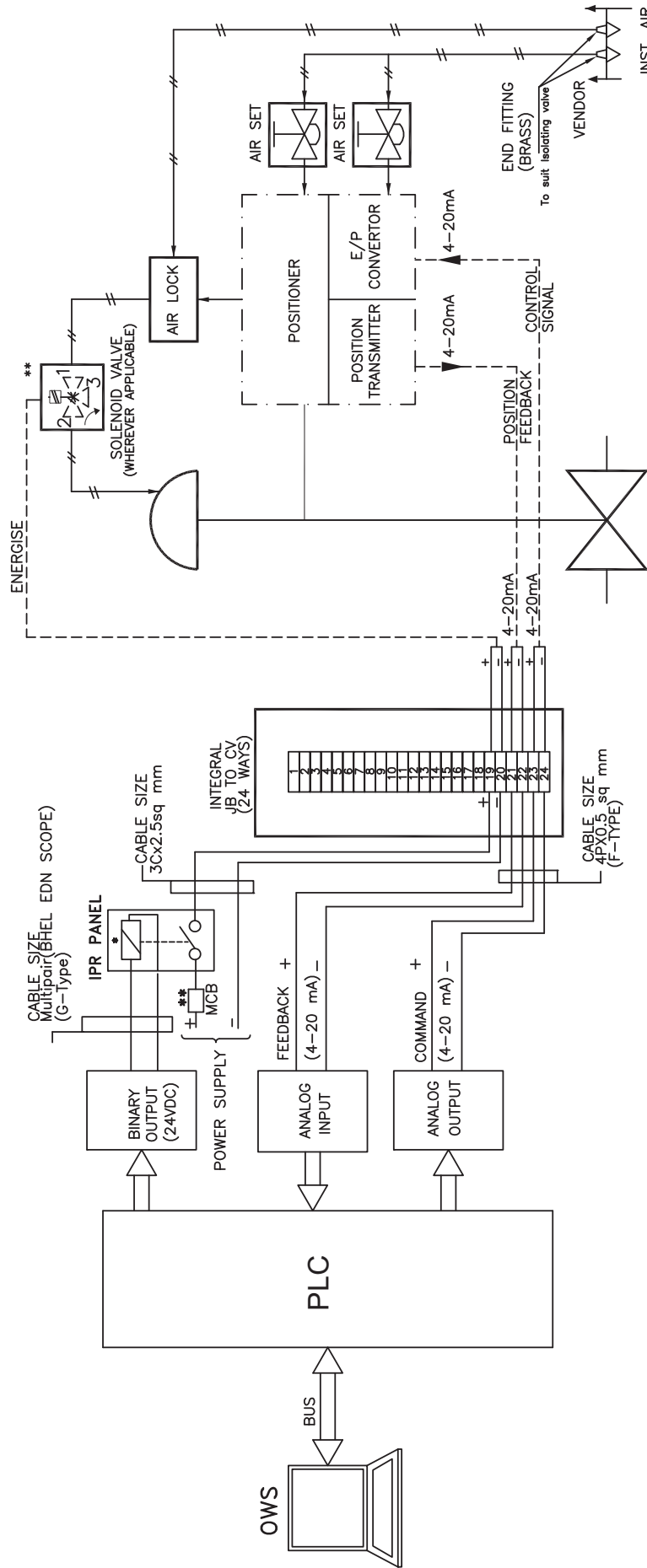
DRG.NO. PE-DM-411-145-1002

DATE 06.02.2015

REV.NO. 01

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PLC INTERFACE FOR ANALOG DRIVE



NOTES:

- * APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.
- ** MCB SHALL BE PROVIDED FOR EACH SOLENOID



PROJECT: 4 X 270 MW BHADRADRI TPS

TITLE TYPICAL HOOK-UP DIAGRAM
ANALOG DRIVE(WITH SMART POSITIONER)

DRG.NO. PE-DM-411-145-1002

DATE 18.11.2014

REV.NO. 00

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Technical specification for
CONTROL & INSTRUMENTATION
4 X 270 MW BHADRADRI TPS

SPEC NO.: PE-TS-411-145-I

VOLUME

SECTION

REV. NO.

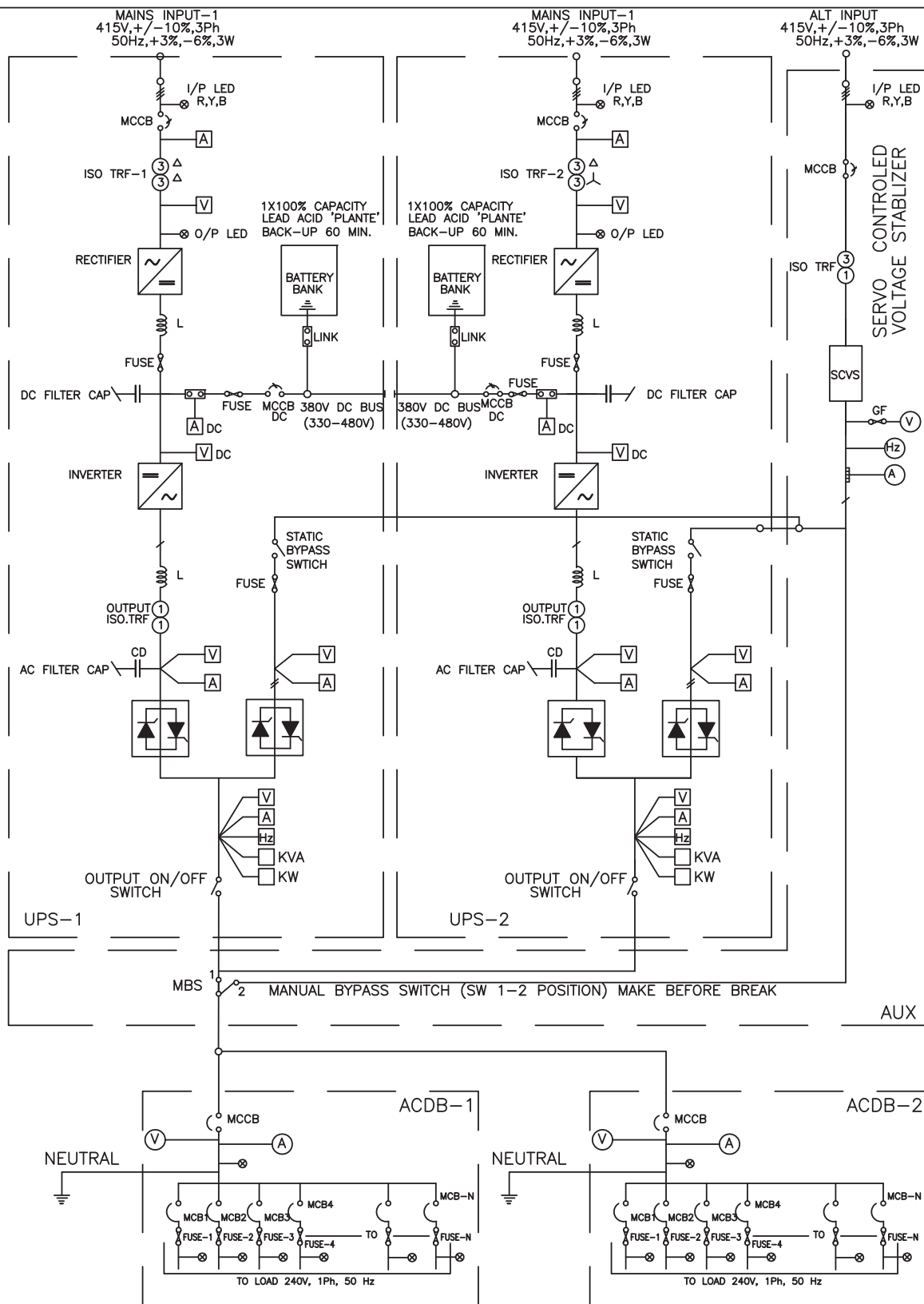
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DATE : 19.03.2015

SHEET

OF

UPS SCHEME



4 X 270 MW BHADRADRI TPS

TITLE:-

UPS SINGLE LINE DIAGRAM

DRG.
No.

PE-DM-411-145-I900

REV.
No.

02

DATE

01.07.2015

SHEET

11

OF

11



Technical specification for
CONTROL & INSTRUMENTATION
 4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

SHEET

OF

INSTRUMENTATION DATA SHEET

1.00.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS

1.01.00 PRESSURE TRANSMITTER

1. Working Principle : Smart (HART Compatible)
2. Type : Microprocessor based, 2 – Wire
3. Output Signal : 4-20 mA DC along with superimposed digital signal
4. Measuring Element : Capsule / Diaphragm
5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10. Output Indicator : LCD (Integral indicator of 5 digit display)
11. Nameplate : Tag number, service engraved in SS tag plate
12. Body : SS
13. Operating Voltage : 24V DC
14. Load : 600 Ohms (min.) at 24 Volts D.C.
15. Ambient Temperature : 0 - 50 °C
16. Performance: :
 - i. Accuracy : $\pm 0.075\%$ of Span or better

- ii. Repeatability : $\pm 0.05\%$ of Span or better
17. Sealing/Isolation : Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18. Accessories :
- a. Universal mounting bracket suitable for 2" pipe mounting
 - b. High tensile carbon steel U-bolts
 - c. Siphon for steam and hot water services
 - d. 1/2" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock
 - e. Companion flange with nuts, bolts and gaskets
 - f. 1/2" NPT cable gland
 - g. Handheld calibrator
19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

Notes: For primary air/ secondary air/ flue gas applications, DP type transmitters shall be provided for pressure measurement. LVDT type is not acceptable.

1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER

- 1. Working Principle : Smart (HART Compatible)
- 2. Type : Microprocessor based, 2 – Wire
- 3. Output Signal : 4-20 mA DC along with superimposed digital signal
- 4. Measuring Element : Capsule / Diaphragm

5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10. Output Indicator : LCD (Integral indicator of 5 digit display)
11. Nameplate : Tag number, service engraved in SS tag plate
12. Body : SS
13. Operating Voltage : 24V DC
14. Load : 600 Ohms (min.) at 24 Volts D.C.
15. Ambient Temperature : 0 - 50 °C
16. Performance:
 - i. Accuracy : $\pm 0.075\%$ of Span or better
 - ii. Repeatability : $\pm 0.05\%$ of Span or better
17. Sealing/Isolation : Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18. Accessories :
 - a. Universal mounting bracket suitable for 2" pipe mounting
 - b. High tensile carbon steel U-bolts

- c. Siphon for steam and hot water services
- d. ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock
- e. Companion flange with nuts, bolts and gaskets
- f. ½" NPT cable gland
- g. Handheld calibrator

19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

1.03.00 Displacer Type Level Transmitters

- 1. Type : Smart (HART Compatible)
- 2. Stages of operation : Continuous
- 3. Material :
- 4. i. Displacer SS-316
- 5. ii. Suspension wire SS-316
- 6. iii. Torque tube housing SS
- 7. iv. Torque tube Inconel
- 8. v. Displacer chamber SS
- 9. vi. Transmitter Housing SS
- 10. Operating Voltage : 24 V DC
- 11. Transmission : Microprocessor based, 2-wire
- 12. Output Signal : 4-20 mA DC along with superimposed digital signal
- 13. Static / overload : Maximum static pressure without

	pressure		permanent deformation or loss of accuracy
14.	Turn-down ratio	:	10 : 1 or better
15.	Zero & Span	:	Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
16.	Enclosure Class	:	IP-65
17.	Output Indicator	:	LCD type (Integral indicator of 5 digit display)
18.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
19.	Ambient Temperature	:	0 - 50 °C
20.	Load Impedance	:	600 Ohms at 24 Volts (minimum)
21.	Process Connection	:	2" Flanged
22.	Performance - Accuracy	:	± 0.075 % of span or better
23.	Accessories	:	a) Counter Flange, nuts, bolts, gaskets etc b) Weights for 5 point calibration of instruments c) Vent and drain plugs d) ½" NPT Glands e) Handheld calibrator
24.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics b) Electronic Damping facility (adjustable)
25.	Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system

-
26. Applications : During detail engineering on Owner's approval
- 1.04.00 MASS FLOW METER
- 1.04.01 SENSOR
1. Measuring Principle : Coriolis Mass flow
 2. Primary Element : Flow Tube of 316SS or better
 3. Heating Arrangement : Integral
 4. Temperature Control : For heavy fuel oil application
 5. Process Connection : Flanged of rating as per process requirement
 6. Drain : Self-draining facility
 7. Enclosure : Stainless steel
 8. Accessories : Counter flanges, Mounting nuts, bolts, gaskets etc.
- 1.04.02 TRANSMITTER
1. Measured quantities : Mass Flow rate, Total Mass Flow, Density
 2. Input Signal Processing : Smart (HART compatible)
 3. Display : LCD
 4. Output : 2 nos. isolated output of 4-20mA DC selectable from four measured quantities
 5. Load : < 750 ohms
 6. Power supply : 240V AC, 50 Hz

7. Turn Down : 100:1
8. Accuracy : ± 0.2 % of measured value
9. Housing : IP 65 (Explosion proof)
10. Nameplate : Tag number, service engraved in stainless steel tag plate
11. Accessories :
 - a) Handheld calibrator
 - b) Mounting U-bolts, nuts, bolts, prefab cable etc
 - c) $\frac{1}{2}$ "NPT cable gland
12. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system
13. Applications : Fuel Oil service

1.05.00 RADAR TYPE LEVEL MEASUREMENT

1. Type : Smart (HART Compatible)
2. Antenna : Co axial / guided wave radar / Overspill protection
3. Principle : TDR (Time Domain Reflectometry)
4. Communication : Two wire 4-20mA DC with HART
5. Environmental temperature : 0 – 50 °C
6. Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
7. Calibration :
 - a) Self calibration with internal reference
 - b) Zero & Span calibration
8. Process Connection : External cage mounting
Flanged /screwed
9. Electronic Housing : Epoxy painted Die-Cast aluminium

		alloy	
10.	Antenna / Flange assembly	:	316 SS or Hest alloy (as required)
11.	Power supply	:	24 V DC
12.	Output Indicator	:	LCD
13.	Accuracy	:	5 mm or 0.1% of probe length
14.	Accessories	:	a) Handheld calibrator
		:	b) Counter Flange, nuts, bolts, gaskets etc
		:	c) ½"NPT cable gland
		:	d) SS Nameplate
15.	Adjustment/Calibration/ /Maintenance	:	From handheld calibrator/ HART management system
16.	Applications	:	Vessels under vacuum or low pressure applications, solid levels
1.06.00	ULTRASONIC LEVEL TRANSMITTER		
1.	Type	:	Microprocessor based, 2-wire, Smart (HART Compatible)
2.	Operating Principle	:	Detection of reflected ultrasonic pulse
3.	Output Signal	:	4-20 mA DC along with superimposed digital signal
4.	Operating frequency	:	10 KHz to 50 KHz (typical)
5.	Display	:	LCD
6.	Temperature Compensation	:	Built in –Programmable
7.	Power supply	:	24 V DC
8.	Enclosure	:	SS, IP-65 (Explosion proof for NEC Class-1, Division 1 area)

9. Zero & Span : Continuous, tamper proof, remote as well locally adjustable. It shall be possible to calibrate the instrument without any level in the sump/ tank
10. Accuracy & Repeatability : 0.15 % of span or better
11. Resolution : 0.1 % of span
12. Operating temp. : Transmitter- 500 C and Sensor - 800 C
13. MOC Sensor : SS-316/Body- PVC and Face – Polyurethane
14. Mounting : 4" Flanged/ 2" NPT for sensor and Transmitter on panel
15. Accessories :
 - a) Handheld calibrator
 - b) Weather canopy for protection from direct sunlight and direct rain
 - c) ½"NPT cable gland
 - d) All mounting hardware (SS-316), Prefab cable
 - e) SS Nameplate
16. Diagnosis : On-line
17. Status Indication : Power On, HI, HI-HI, Lo, LO-LO, Fault
18. Output Contacts : 2 SPDT, 230V, 5A
19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system
20. Applications : Coal Bunker, Water Service etc.

1.07.00 ULTRASONIC FLOW TRANSMITTER

1. Type : Ultrasonic – Clamp On
2. Accuracy : +/- 1 % of reading
3. Repeatability : +/- 0.3 % of reading
4. Rangeability : 400 : 1
5. Output Signal : 4-20 mA DC with HART
6. Measured Parameter : Volumetric flow, Totalized flow and flow Velocity
7. Display : LCD with internal Key Pad (Flow rate & Totalization)
8. Power Supply : 24 V DC (2 Wire)
9. Enclosure : SS (IP- 68 – Submersible)
10. Mounting : SS Chain or Strap
11. Accessories
 1. Handheld calibrator
 2. ½"NPT cable gland
 3. Transducer cable
 4. All mounting hardware (SS-316)
 5. SS Nameplate
12. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system
13. Applications : Plant water service

Note: Multi-path insertion type (minimum 4 path) Ultrasonic Flow meter shall be provided for Raw water/ Cooling Water flow measurements.

2.00.00 ~~HART HAND HELD CALIBRATOR~~

~~Hand held calibrators (5 nos. for each type) shall be provided for adjustment/ calibration/maintenance of the HART compatible~~

~~transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.~~

3.00.00 **PROCESS ACTUATED SWITCHES**

3.01.00 PRESSURE SWITCH

1. Type :
 - i. Piston for high pressure application
 - ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS $\frac{1}{2}$
4. Setter Scale : Black graduation on white linear scale.
Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure
6. Adjustments :
 - a) Internal Set Point
 - b) Differential adjustment
7. End Connection : 1/2" NPT bottom connected
8. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
9. Switch Type : Snap acting, shock & vibration proof
10. Terminal Block : Suitable for full ring lugs
11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12. Performance :
 - a) Repeat accuracy $\pm 1.0\%$
 - b) Accuracy of Setting Indication of $\pm 1.5\%$
13. Ambient temperature : 0 – 50 Deg.C

14. Nameplate : Tag number, service engraved in SS tag plate
15. Accessories : a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary for corrosive/ viscous/ solid bearing or slurry type fluid applications
b) Snubbers for pulsating fluid applications
c) Siphons for steam and hot water services
d) Retention ring and screws for surface mounting
e) 1/2" NPT 2 Valve SS-316 barstock manifold
f) 1/2" NPT cable gland
16. Applications : During Detail Engineering on Owner's approval

3.02.00 DIFFERENTIAL PRESSURE SWITCH

1. Type : i. Piston for high pressure application
ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS
4. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure

- | | | |
|-------------------------|---|--|
| 6. Adjustments | : | a) Internal Set Point |
| | : | b) Differential adjustment |
| 7. End Connection | : | 1/2" NPT bottom/ back connected |
| 8. Switch configuration | : | Two SPDT (240V, 5A AC/220V, 0.5A DC) |
| 9. Switch Type | : | Snap acting, shock & vibration proof |
| 10. Terminal Block | : | Suitable for full ring lugs |
| 11. Enclosure Class | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 12. Performance | : | a) Repeat accuracy $\pm 1.0\%$ |
| | | b) Accuracy of Setting Indication of $\pm 1.5\%$ |
| 13. Ambient temperature | : | 0 – 50 Deg.C |
| 14. Nameplate | : | Tag number, service engraved in SS tag plate |
| 15. Accessories | : | a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary Diaphragm seals for corrosive/ viscous/ solid bearing or slurry type fluid applications |
| | | b) Snubbers for pulsating fluid applications |
| | | c) Siphons for steam and hot water services |
| | | d) Retention ring and screws for surface mounting |
| | | e) 1/2" NPT 5 Valve SS-316 barstock manifold |
| | | f) 1/2" NPT cable gland |
| 16. Applications | : | During Detail Engineering on Owner's |

approval

3.03.00 LEVEL SWITCH

3.03.01 FLOAT OPERATED

1. Float material : SS-316
2. Wetted parts : SS-316
3. Float chamber : Stainless steel/Carbon steel,
construction welded
4. Float chamber : Side mounted
mounting
5. Fluid connection : Side – Side
6. Fluid connection size : 1" ANSI RF Flange (rubber line, if
required)
7. Drain : ½ inch NPT with Plug
8. Pressure rating of
chamber : Minimum 1.5 times of design pressure
9. Repeatability : +/- 1.5 mm or better
10. Switch housing : Stainless Steel
11. Switch housing type : IP- 65
12. Type of switch : Snap acting magnetically operated
hermetically sealed
13. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
14. Accessories : a) Counter flange, nuts
& bolts, suitable
gasket etc.
b) Steel globe type
drain valve
c) ½"NPT cable gland

d) Stainless steel nameplate with alpha-numeric engraved for service and tag

15. Application : During Detail Engineering on Owner's approval

3.04.00 FLOW SWITCH

1. Type : Paddle /Piston/Disk
2. Wetted part material : Stainless steel or Hastelloy for acidic application
3. End connection :
 - a) Threaded upto 1" line size with integral Tee
 - b) Flanged for line size > 1 ½"
4. Enclosure material : Stainless Steel
5. Enclosure class : IP 65
6. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
7. Repeatability : 2%
8. Cable connection : ½"NPTF
9. Accessories :
 - a) Tee, Counter flange, nuts & bolts, suitable gasket etc
 - b) ½"NPT cable gland
 - c) Stainless steel nameplate with alpha-numeric engraved for service and tag

3.05.00 RF LEVEL SWITCH

1. Type : RADIO FREQUENCY
Sensing probe
2. Material : SS-316
3. Mounting : Threaded
4. Application : 250°C (Max.)
Temperature
Electronic Controller
5. Input Supply Voltage : 240V AC $\pm 10\%$, 50 Hz.
6. Relay Output : 2 SPDT (240V AC, 5A)
7. Ambient Temperature : 50 °C
8. Enclosure Protection : IP-66
9. Enclosure Housing : SS
Normal Level
10. Local LED Indication : Power On
Alarm Level
Probe Healthy
11. Switching Repeatability : $\pm 0.5\%$
Co-axial cable for probe connection to
controller
12. Accessories : SS Tag plate
 $\frac{1}{2}$ " NPT Cable Glands
13. Application : Solid level

3.06.00 CONDUCTIVITY TYPE LEVEL SWITCH

1. Type : Conductivity discrimination
2. Probe MOC : SS-316
3. Mounting : Flanged on external cage
4. Application : 250°C (Max.)
Temperature
5. Test Pressure : Two times rated pressure

6. Input Supply Voltage : 240V AC $\pm 10\%$, 50 Hz.
Four independent channel with
7. Input : selectable switching threshold for water conductivity
8. Relay Output : 2 SPDT (240V AC, 5A)
9. Ambient Temperature : 50 °C
10. Enclosure Protection : IP-65 (Explosion proof for NEC Class-1, Division-1 area)
11. Enclosure Housing : SS
HI,LO, HIGH-HIGH, LOW-LOW
12. Local LED Indication : Power
Fault
13. Accessories :
 - a) Interconnecting cable from probe to electronics
 - b) Mounting accessories
 - c) External cage
 - d) Washer & Gasket
 - e) $\frac{1}{2}$ " NPT Cable Glands
 - f) SS Tag Plate
14. Application : During Detail Engineering on Owner's approval

3.07.00 TEMPERATURE SWITCH

1. Type : Bimetallic or gas filled
2. Sensing Element : SS-316
Material
3. Bulb Material : SS-316
4. Capillary : Stainless Steel armored

5. Movement Material : Stainless Steel
6. Case material : Stainless Steel with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
- 7.. Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
8. Over range Protection : 120 %
9. Instrument connection : Bottom
10. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
11. Switch type : Snap acting, shock and vibration-proof
12. Adjustability : Internal Set point adjustable over span range
13. Compensation :
 - a) Capillary compensation with invar wire throughout the capillary length
 - b) Case compensation
14. Performance
 - a) Scale Accuracy : ± 1.0 % of full scale
 - b) Repeatability : < 0.5 % of full range
 - c) Response time : Less than 40 seconds with thermowell
15. Capillary length : 5 meters (minimum) for local mounting/15 meters for local panel mounting
16. Nameplate : Tag number, service engraved in stainless steel tag plate
17. Accessories : Mounting accessories, $\frac{1}{2}$ " NPT cable gland
18. Applications : During Detail Engineering on Owner's

approval

4.00.00 **LOCAL INSTRUMENTS**

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

1. Type : Bourdon/Bellows/Diaphragm
2. Sensing & Socket : SS-316
3. Movement Material : SS-316
4. Case Material : Stainless steel. IP-65 (Explosion proof for NEC Class-1, Division 1 area)
5. Dial Size : Generally 150 mm
6. Scale : Black lettering on white in 270 O arc.
7. Window : Shatterproof glass
8. Range Selection : Normal process pressure: 50~70 % of range
9. Over-range Protection : 125% of maximum range by internal stop. External stop at zero
For Zero adjustment (Micrometer screw external)
10. Adjustment : For Range adjustment (Micrometer screw internal).
11. Element Connection : Argon welding
12. Process Connection : 1/2" NPT (M) Bottom for local, back for panel mounting
13. Performance : Accuracy of ± 1.0 % of span or better
14. Operating ambient : 0 - 50 °C
15. Safety Feature : Blow out disc /diaphragm at the back
16. Accessories : a) Snubbers for pulsating fluid application.discharge
b) Stainless steel Diaphragm seals

- for corrosive/ viscous/ solid bearing or slurry type fluid applications
- c) 3-Way SS316 Gauge cock for pressure gauges
- 5-valve SS316 manifold from
- d) barstock for differential pressure gauge
- e) Siphons for steam and hot water services
17. Nameplate : Tag number, service engraved in stainless steel tag plate

4.02.00 LEVEL INDICATOR (FLOAT & BOARD TYPE)

1. Type : Float and Board
2. Float Material : SS-316
3. Float Cable : SS-316
4. Indicator Assembly : Epoxy painted Aluminium
5. Guide wire spring assembly : SS-316 (2 Nos.)
6. Guide Wire Anchor : SS-316
7. Scale Board : Anodized Aluminium with engraved marking (Minimum graduation 10mm), mounting brackets and suitable hardware required as per tank height
8. Elbow Assembly : Anodized Aluminium
9. Flanges : RF , ANSI 150 , SS (3 Nos.)
10. Accuracy : ± 10 mm or better
11. Accessories : All mounting accessories including counter flange, nuts & bolts, suitable

gasket etc. as applicable, SS Tag plate

4.03.00 GAUGE GLASS

1. Type : Reflex /Transparent
2. Material : Toughened borosilicate resistant to thermal shock
- Body Material : ~~Carbon Steel~~ Stainless Steel
- Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
3. Integral cocks & valves/Fittings : i. SS 316
4. : ii. Rubber lined corrosion resistant stainless steel (for DM/RO service)
5. Vessel Connection : ANSI Flanged SS316
6. Accessories : i. Integral cocks
- ii. Drain Valves
- iii. Companion Flanges, Bolts, nuts, gaskets, SS Tag plate
- iv. Illuminating lamps, Mica shield as required
- v. Calibrated scale
7. Pressure rating : Twice the maximum working pressure
8. Temperature : 300 °C
9. Other details : For larger lengths (greater than 1200mm), additional gauge glasses shall be provided with minimum of 50 mm overlap.

- 4.04.00 SLIGHT GLASS
1. Type : Flap-type.
 2. End connection : Screwed / Flanged
 3. Material
 - a) Body : SS- 304
 - b) Cover plate : SS- 304
 - c) Indicator : SS- 316
 4. Sight Glass : Toughened Borosilicate
 5. Gasket : Neoprene
 6. Bolts & Nuts : High tensile steel.
 7. Hydraulic Test Pressure : 1.5 times maximum working pressure
 8. Accessories : Companion Flanges, Bolts, nuts, gaskets as required, SS Tag plate.
- 4.05.00 ROTAMETER
1. Type : ON-LINE for line upto and including 50 mm NB.
: Borosilicate BY-PASS for line size above 50 NB
 2. Metering tube : Toughened Borosilicate
 3. Float : SS-316
 4. End fittings : SS-316
 5. Packing material : Teflon / PTFE
 6. Casing : Stainless Steel
 7. Gland Rings : Stainless Steel
/Followers/ Other :
wetted parts
 8. Orifice Plate : Stainless Steel (for bypass type)
 9. Operating Temperature : 0-50 Deg. c

- | | | |
|------------------------|---|--|
| 10. Test Pressure | : | 200% of maximum operating pressure |
| 11. Scale | : | 250 mm nominal length |
| 12. Graduation | : | Direct reading |
| 13. Process Connection | : | Flanged (RF) to line size as per ANSI standards (150#) |
| 14. Tapping | : | D & D/2 |
| 15. Accuracy | : | +/- 2% of full scale reading |
| 16. Reproducibility | : | Within 0.5% of instantaneous reading |
| 17. Accessories | : | SS Tag Plate, orifice plate |

5.00.00 **TEMPERATURE ELEMENTS & ACCESSORIES**

5.01.00 RESISTANCE TEMPERATURE DETECTOR

- | | | |
|----------------------------------|---|--|
| 1. Type | : | Platinum (Duplex), Ungrounded |
| 2. Platinum (Duplex), Ungrounded | : | 100 ohm at 0 °C |
| 3. Base | : | Wound on ceramic (anti-inductive) |
| 4. Wiring | : | 3 Wire |
| 5. Protecting Tube | | |
| a) O.D. | : | 6 mm |
| b) Material | : | SS-316, Seamless |
| c) Filling | : | Magnesium oxide (Purity above 99.4%). |
| 6. Response time | : | a) 15 sec. (bare).
b) 30 sec. (with thermowell) |
| 7. Calibration | : | DIN 43760 |
| 8. Accuracy | : | ± 0.5% |
| 9. Head | | |
| a) Type | : | IP-65 universal screwed type |

- b) Material : Stainless Steel
- c) Terminal blocks : Nickel plated Brass-screw type / silver plated
- d) Cable connection : ½" NPT gland and grommet
- e) Others : Terminal head cover with SS chain and suitable gasket.
- Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).
- Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT] with thermowell connection
10. Accessories : a)
- b) Compression fittings/unions
- Flanges etc. (for flanged
- c) connections only)
- Thermowell (As specified
- d) below)
11. Thermowell connection : ½" NPT (M) or 150 RF Flanged
- Tag number, service engraved in
12. Nameplate : stainless steel tag plate

Note: The specifications for RTDs of winding/ bearing of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be Pt-100.

5.02.00 THERMOCOUPLES

1. Type :
 - a) 16 SWG wire of Chromel AlumeI) (Type-K)
 - b) Duplex
 - c) Ungrounded
2. Protecting Tube
 - a) O.D. : 6 mm
 - b) Material : SS-316, Seamless
 - c) Filling : Magnesium oxide (Purity above 99.4%).
3. Response time :
 - a) < 20 seconds for measurement
 - b) < 10 seconds for control
4. Accuracy : $\pm 1.1^{\circ}\text{C}$ up to 300°C & 0.4% of measured temperature range above 300°C
5. Head
 - a) Type : IP-65 universal screwed type
 - b) Material : Stainless Steel
 - c) Terminal blocks : Nickel plated Brass-screw type / silver plated
 - d) Cable connection : $\frac{1}{2}$ " NPT gland and grommet
6.
 - e) Others : Terminal head cover with SS chain and suitable gasket.

Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

7. Accessories :
 - a) Adjustable nipple-union-nipple [1/2" Sch 80 X 1/2" NPT] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Thermowell (As specified below)
8. Thermowell connection : 1/2" NPT (M) or 150 RF Flanged
9. Nameplate : Tag number, service engraved in stainless steel tag plate

5.03.00 TEMPERATURE GAUGE

1. Type : Expansion type (Liquid filled system)
2. Sensing Element : Bourdon – SS-316
3. Material : SS-316
4. Bulb and Capillary : SS-316
5. Capillary Tubing : Inner sheath - solid drawn Material
Outer sheath - PVC tube
6. Movement Materials : Stainless Steel / Direct Bourdon tip connection to pointer spindle
7. Case Material : Stainless Steel stove enameled, black finish, threaded bezel ring, clear glass

- cover conforming to IP 65.
7. Dial size : 150 mm
 8. Scale : Black lettering on white background in 270 Deg.C arc
 9. Over range protection : 125 percent of FSD
 10. Capillary Glanding : 1/2" NPT(M) x compression fitting (SS) to suit capillary
 11. Instrument Connection : Bottom connection for local mounting, back connection for panel mounting
 12. Process Connection : 1/2" NPT (M) or 150 RF Flanged
 13. Extension Neck Length : 50 mm
 14. Compensation : a) Capillary compensation
 15. : b) Case compensation
 16. Performance : a) Accuracy : + /- 1.0 percent of full scale Deflection
 - : b) Repeatability : Less than 0.5 percent of full range
 - : c) Response time: 15 seconds (max.).
 17. Capillary length : 3.0 meters (local) / 15.0 metres (local panel)
 18. Other features : Shatter proof glass
 19. Nameplate : Tag number, service engraved in stainless steel tag plate
 20. Accessories : SS316 Thermowell

5.04.00 THERMOWELL

1. Material : SS-316
2. Manufacture : Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)

3. Process connection : M33x2
4. Certification : Not applicable
5. Bore concentricity : +5% of wall thickness
6. Identification mark : Tag number punched on head
7. Surface treatment : Polish after machining
8. Element connection : ½" NPT (M) or 150 RF Flanged
9. Head : Hex
10. Length of the hex head : 31.75 mm (min.)
11. Accessories : SS Plug and chain for test thermo wells
SS Nameplate, Flange with companion
flange & all required accessories for
flanged connections.

Note: Wake frequency calculations shall be furnished for all thermowells for approval.

Thermowells shall be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid.

5.05.00 METAL TEMPERATURE THERMOCOUPLE

1. Measuring medium : Metal temperature
2. Type : Chromel Alumel (Type-K)
Duplex, Ungrounded
3. Insulation : Mineral Insulation Magnesium Oxide
4. Wire gauge : 16 AWG
5. Protective sheath : SS
6. Protective sheath :
diameter : 8 mm O.D.
7. Characteristics : Special limits of error as in ANSI
thermocouple MC 96.01
8. Accessories : ½" BSP SS sliding end connector, weld
pad, clamps of heat resistant steel

1. Type : Hydrometer Type
2. Mounting : On line
3. Accuracy : +/- 2% of range
4. Scale : Black letter on white scale
5. End connection : PVC flange

9.06.00 DENSITY/ CONCENTRATION METER

1. Wetted Part : Stainless Steel
2. Enclosure : Stainless Steel (IP-65)
3. Power Supply : 24 V DC
4. Output signal : 4-20 mA DC (isolated) into 600 ohms
5. Accuracy : ± 0.001 g/cc
6. Indication : LCD display
7. Temp. Compensation : Integral
8. Accessories : Mounting hardware, integral amplifier
(if required), cable glands, tag plate
etc.

10.00.00 SOLENOID VALVES

1. Operating Principle : Electromagnetic (noiseless)
2. Coil voltage rating : 240 V AC /24 V DC (as required)
3. Ways : 2/3/4 way
4. Port size : 1/4" NPT all ports
5. Body : SS bar stock
- Trim : SS-316
6. Duty : Suitable for continuous energization
7. Sealing : Airtight and leak proof
8. Ambient Temperature : 0 - 50 ° C

-
- | | | | |
|-----|-------------------|---|--|
| 9. | Fluid Temperature | : | 0-150 ° C (approx.) |
| 10. | Coil Enclosure | : | Stainless Steel |
| 11. | Insulation | : | Class-H |
| 12. | Coil Casing | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area) |
| 13. | Mounting | : | On pipe or on panel |
| 14. | Cable Connection | : | ½" NPT |
| 15. | Accessories | : | Cable glands, SS Tag plate |



Technical specification for
CONTROL & INSTRUMENTATION
4 X 270 MW BHADRADRI TPS

SPEC NO.: PE-TS-411-145-I

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

SHEET

OF

Instrumentation Check List



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

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 :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified 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 :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- When material corelation are not available manufacturer's compliance to be provided.
- 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 SENSOR TYPE DIAL SIZE MODEL NO/TAG NO RANGE/SCALE SWITCH CONTACT RATING & NOS. END CONNECTION	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
2	CALIBRATION ACCURACY REPEATABILITY SET POINT ADJUSTMENT			P	W	V	
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR MATERIALS OF SENSOR MOVEMENT PROCESS CONNECTION HOUSING	FOR LOT		V	V	V	
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 :

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P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- When material correlation is not available, MFR's compliance to be provided
- Contractor to provide compliance certificate for tests/checks verified 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	ONE / LOT		P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR			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 :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified 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 :

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



Technical specification for
CONTROL & INSTRUMENTATION
 4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

SHEET

OF

LCP & JUNCTION BOXES SPECIFICATION

- 1.00.00 **GENERAL REQUIREMENT**
- 1.01.00 **ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT**
- 1.01.01 All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.
- 1.02.00 **SURFACE PREPARATION & PAINTING**
- 1.02.01 All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.
- 1.02.02 Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.
- 1.02.03 Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:
- Exterior – Opaline green shade 275 of IS: 5 or equivalent international code..
 - Interior - Brilliant White.
- 1.02.04 Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.
- 1.03.00 **WIRING**
- 1.03.01 All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.
- 1.03.02 Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.
- 1.03.03 All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

- 1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.
- 1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices
- 1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- 1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.
- 1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.
- 1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- 1.03.10 Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.
- 1.03.11 Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue failure of the conductor.
- 1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation color-coding identified on drawings or by printed wiring lists.

- 1.04.00 TERMINAL BLOCKS
- 1.04.01 All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.
- 1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.
- 1.04.03 The characteristics of the terminal blocks shall be as follows.
- i) High contact force, independent of conductor cross-section and large contact surface area.
 - ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
 - iii) Inspection and maintenance free (resistant to thermal aging and vibration)
 - iv) Low and constant voltage drop
- 1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.
- 1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.
- 1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.
- 1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.
- 1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

- 1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.
- 1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- 1.04.11 Other requirements of the terminal blocks are as follows:
- i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
- 1.05.00 **GROUNDING**
- 1.05.01 Separate Protective and Electronic system ground as required shall be provided.
- 1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.
- 1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground. The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open. The electronic ground between panels of a shipping section shall be firmly looped.
- 2.00.00 **CONTROL DESKS & PANELS**
- 2.01.00 **GENERAL**
- 2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping &

- accessories as required for completeness of the system.
- 2.01.02 The design shall conform to the EN ISO 11064 (Ergonomical design of Control Room), Part 1, 2 and 3.
- 2.01.03 The exact dimensions, material, construction details, grounding, general arrangement etc. shall be as per actual requirement and shall be finalized during detail engineering and subjected to Owner's approval.
- 2.01.04 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 2.01.05 For Control desk/ panel mounted instruments/ devices etc. which are to be powered from UPS, all required conversion of interface equipments/ accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.
- 2.01.06 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 2.01.07 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
 - b) Nameplates for panels shall be provided both in front and rear.
- 2.02.00 CONTROL DESK
- 2.02.01 Control desk shall be free standing, floor mounting, table top type with doors at back and shall be constructed of 3 mm thick (minimum) CRCA steel or Aluminium extrusion. Aluminium structure shall be anodized or powder coated paint finish. The top surface of control desk shall be 30 mm (minimum) thick with the top 12 mm (minimum) of acrylic solid surface and the remaining 18 mm of laminated medium density fibre (MDF) board.
- 2.02.02 Monitors with retractable keyboard shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.
- 2.02.03 Desks shall be of modular, scalable and industrially ruggedized design and shall have connections for PA system handsets & telephone sets.
- 2.02.04 Desks shall have concealed cable trays for wire dressing. Both Horizontal & Side Managers (2 separate horizontal cable routing wire baskets for power & data cables) shall be provided.

Each User station will be provided with 2 separate power distribution units (1 for Main line & 1 for UPS line). Each power distribution unit will have 6 points of 5/13 Amp sockets, Mains MCB On/Off Switch & Indicator.

Adequate heat management provision for Exhaust of heat from within the Console Desk Assembly shall be provided. There will be multiple fans provided in the Main Control Desk. Each Fan will be of 230 VAC 250 CFM Ball Bearing based. Ventilation louvers will be provided on both Front & Rear Modesty with special Air Filters. Adequate space for CPU & Other equipments placed with in the desk.

2.02.05 Design shall include Earthing bolts.

2.02.06 Back installed items shall be suitably concealed from front view.

2.02.07 All operator workstations for SG, TG, Auxiliaries & Off-site Plants shall be mounted on this Control Desk. The cabling / wiring between OWS & CPUs, power supply cables etc. shall be aesthetically routed and concealed from view.

2.02.08 HARDWIRED DEVICES ON CONTROL DESK (DRAW OUT SECTION)

Release and Lamp Test push buttons shall be provided for a set of push buttons (decided during detail engineering stage). Depending on the type of control/ function, required number of push buttons/ indicating LEDs & their color, push button stations shall be selected. The size of push button stations shall be 24 x 48 mm or 25 x 50 mm and shall have service inscription details at the front. Emergency push buttons (with cover) shall be mounted on top of Control Desk.

2.03.00 BACK UP PANEL

2.03.01 Construction shall be from CRCA steel of thickness not less than 3mm.

2.03.02 Upright back-up panel shall be provided where hardwired devices shall be mounted on a mosaic grid type console. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat & flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.

2.03.03 DDCMIS Back-up Panel (referred as Unit Control Panel-UCP) shall also mount annunciation fascia (minimum 500 nos.) and the flame monitoring cameras along with other hardwired devices as decided during detail engineering stage by Owner. Color coding shall also subject to Owner's approval.

2.03.04 Colored Mimic for different Off-site plant control systems (as enumerated elsewhere in this specification) and hardwired annunciation system shall also

be mounted on the back up panels.

2.04.00 PANELS/CABINETS

2.04.01 All DDCMIS system modules, power supply components and other Local Control panels (PLC/Relay based) shall be housed in cabinets as specified below.

2.04.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings prior to shipment to the project site.

2.04.03 The Bidder shall ensure that the cabinets are complete & ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets shall only involve connections through multi-pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/ Back up Panel.

2.04.04 All electronic cards, network components, power supply modules etc. located shall be suitably housed in cabinets and shall be neatly arranged in sub-racks. Network components shall be visible in door closed condition (e.g. Glass doors etc.) as approved by Owner.

2.04.05 Bidder shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate.

2.04.06 The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Cooling Fans shall be provided wherever required and this shall be of industrial grade.

2.04.07 TECHNICAL PARTICULARS

1. Material of Construction : Cold Rolled Coal Annealed (CRCA) steel sheet
2. Thickness of Sheet : a) 2.0 mm for faces supporting instruments / terminals
: b) 1.6 mm for other sides and top
3. Construction : Welded throughout as per approved National Standards
4. Post welding operation : a) Grounding of all welds to smoothness
: b) Rounding of corners

- : c) Cleaning of weld spatters
- 5. Panel height : 2300 mm (approx)
- 6. Corners : 7 mm inner radius
- 7. Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm
 - c) Total for a group - 6 mm
- 8. Doors : Double, recessed, turned back edges, full height front & rear
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof
- 9. Gland plates : Removable in sections
4 mm thick (bottom)
- 10. Cable entry : Bottom
- 11. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC – 100 or equivalent for all sides
 - c) Stainless steel buff- finished 2 mm thick kick plate for all sides
 - d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws
 - e) Rubber strips to ensure air

tightness between kick plate and finished floor

f) Lifting hook / Eye bolt

g) Drawing pocket

h) Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixtures

- | | | |
|---------------------------------|---|--|
| 12. Name Plate | : | Both at front and back surface of the panel |
| 13. Fixing of name plate | : | Stainless steel pan head screws |
| 14. Name plate material | : | Laminated phenolic (3 layers) |
| 15. Lettering | : | Black with white engraved |
| 16. Mounting of terminal blocks | : | Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure |

2.05.00 FURNITURE

All the furnitures in the Central / Local control Room (s), Engineers' rooms, Instrument laboratory , SWAS Room & any other rooms with C&I equipments located in different plant buildings under Bidder's scope shall be included in Bidder's scope of supply. Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe.

2.05.01 WORK STATION FURNITURE

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

2.05.02 PC RACK

PC Racks shall be provided to mount CPUs of workstations/PCs of OWS/LVS etc. in control room. For each PC / workstation / monitor at least one chair shall be included.

2.05.03 CHAIRS

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

2.05.04 TABLES

Industry standard computer tables shall be provided & shall be as approved by Owner during detailed Engineering. Glass top teak wood horse shoe shaped table with vertical file mounting arrangement (two layers to house approx. 40 Nos of files and lockable drawers at both ends) for Engineering Room shall be provided.

2.05.05 ALMIRAHs

Steel Almirahs shall be provided for keeping documents in the documentation room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed Engineering.

2.05.06 KEYPAD

One keypad per unit shall be provided for the storing of keys of relevant areas of the unit in the control room.

2.05.07 LOCKERS

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel. Also, lockers of bigger size shall be provided in documentation Room for storing of personal documents. Details shall be finalized and approved by Employer during detailed engineering.

3.00.00 LVS PANEL

3.01.00 An arc shaped Large Video Screen (LVS) panel shall be supplied for mounting large video screens in number of tiers in various Control rooms as specified elsewhere in this specification.

Bidder shall provide and fix ACP cladding around the LVS screen including covering the LVS back side and LVS stand. The cladding will be from floor finish to 600 mm above LVS screen like a self-standing partition with necessary openings for system requirement. ACP paneling shall be with 304 grade & approx. 0.5 mm mirror finish SS strip.

3.02.00 The profile, dimensions and the general arrangement shall be finalized & approved by Owner during detailed engineering. Recommendations, if any, for the control room lighting in order to ensure continuous proper viewing of the LVS screen by the operator & shift incharge (without any fatigue) shall be

- clearly brought out by the Contractor in his offer, alongwith all relevant details/basis.
- 3.03.00 Any other requirement for proper LVS mounting & functioning & viewing shall also be specifically brought out by the Contractor in his offer, along with all relevant details.
- 4.00.00 **LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)**
- 4.01.00 GENERAL
- 4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.
- 4.01.02 Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- 4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.
- 4.01.04 Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- 4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- 4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging
- 4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- 4.01.08 Earth stud shall be furnished at rack for safety grounding.
- 4.02.00 LOCAL INSTRUMENT ENCLOSURE (LIE)
- 4.02.01 Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.
- 4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- 4.02.03 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

member, which would reduce access, shall be avoided.

- 4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- 4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.
- 4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- 4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.
- 4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..
- 4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.
- 4.02.10 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- 4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations
- 4.03.00 LOCAL INSTRUMENT RACK (LIR)
- 4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or

falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.

4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.

4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.

4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack

4.03.06 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.04.00 JUNCTION BOX

1. Type of Enclosure : Dust tight & weatherproof conforming to IP 65
2. Material : 3 mm sheet steel / fiberglass reinforced polyester(UV stabilized)
3. Type of Cover : Solid unhinged with retention chain / Screwed at all four corners
4. Paint :
 - i) Exterior : Opaline green shade 275 of IS: 5
 - ii) Interior - Brilliant Glossy White.

- Surface / Two (2) inch Pipe stanchion
5. Mounting : (At a dry compartment at one side of the enclosure / rack with front opening type door)
6. Cable Entry : 3 mm (min) Bottom / side Gland plate
7. Gasket : Neoprene
8. Grounding : Brass earth lug with green screw head
External-2 nos , Internal-1no. (M6)
9. Number of Drain Holes : Two at bottom capped
10. Identification : Label for JB and Tags for cable
11. Accessories : Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
- b) Cable gland (Brass) & raceways
- c) Ferrules & lugs (Brass)
- d) Aluminum back panel
- e) Canopy at top
- f) Mounting brackets
- g) bolts and nuts made of brass etc.

	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, Volume IV of contract specification)		☐ EPOXY ENAMEL ☐ EPOXY POWDER COATED	
	MIMIC (TYPE OF MIMIC- MATERIAL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		☒ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ LIGHT GREY ☐ OPALINE GREEN	
	FINISH (EXTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH (INTERNAL) (As per Annex-1, Section 7.6, Volume 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 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				
NAME DESIGNATION SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:	
	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI		
	SR.ENGR	DY.MNGR	D. GM		
	16.09.2013	16.09.2013	16.09.2013		

	DATA SHEET FOR LOCAL PANELS		SPECIFICATION NO.: PE-SS-999-145-054A	
			VOLUME	
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			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 MIMIC THICKNESS OF MIMIC			
	PANEL COLOUR (INTERNAL)			
	FINISH (INTERNAL)			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PE-SS-999-145-054A	
				VOLUME	
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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				
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY		COMPANY SEAL NAME: SIGNATURE: DATE:
	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI		
	16.09.2013	16.09.2013	16.09.2013		



Technical specification for
CONTROL & INSTRUMENTATION
 4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

SHEET

OF

LCP Quality Plan

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056			
												VOLUME IIB			
												SECTION D			
												REV. NO. 01			
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 ^s			Remarks			
									P	W	V				
1.0	INCOMING 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. Relevant standard	Factory Std. Relevant standard	Log Book	2	---	---				
		4. Mill marking	MA	Visual	100%			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															
P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor															

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056												
										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's			Remarks
																			P	W	V	
		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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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks								
									P	W	V									
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	--	--									
			MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	--	--									
			MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	--	--									
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI	Measurement	100%	Approved Mfr. drgs. Factory Standard	Approved Mfr. drgs. Factory Standard	Log Book	2	--	--									
			MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	--	--									
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	--	--									
			MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	--	--									
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	--	2									
			MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	--	2									
			MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	--	2									
			MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	--	2									

LEGEND: * CR
MA
MI

- Critical characteristics
- Major characteristics
- Minor characteristics

\$
P
W
V

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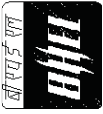
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
9.0	Pre-treatment and Painting	1. Pretreatment Process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

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 STD QUALITY PLAN NO.: PE-QP-999-145-1056 VOLUME IIB SECTION D REV. NO. 01 DATE: 22-02-2008 SHEET 5 OF 7		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL												
		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	
10.	Panel Wiring	1. Wiring Layout 2. Wiring Termination (Crimped Lugs) 3. Ferrule numbers 4. Colour of wiring 5. Size of Conductor	MA MA MA MA MA	Visual Visual Visual Visual Measurement	100% 100% 100% 100% 100%	Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs.	Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2	---	---	---	---		
11.	Component Mounting	1. Correct components 2. Fixing	MA MA	Visual Visual	100% 100%	Approved drgs., Specs. & BOM Approved drgs., Specs. & BOM	Log Book Log Book	2 2	---	---	---	---		
12.	FINAL Final Inspection	1. Workmanship 2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components 3. Components identification Marking / Name plates	MA MA MA	Visual Visual Visual	100% 100% 100%	Factory Standard BHEL approved drg. / Spec. BHEL approved drg. / Spec.	Inspection Report Inspection Report Inspection Report	2 2 2	1 1 1	1 1 1	1 1 1	At Random by BHEL, based on 100 % internal test reports by Mfr.		

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 STD QUALITY PLAN NO.: PE-QP-999-145-1056		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										
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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		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	

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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	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1				
		2. Instrument Calibration	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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Technical specification for
CONTROL & INSTRUMENTATION
 4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

SHEET

OF

PC SPECIFICATION



Technical specification for
Computer
For
4X270 MW BHADRADRI TPS

SPEC NO.: PE-TS-411-145-I

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

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SPECIFICATION FOR PC

a. CPU

1. Processor : Intel core i5 or better, 32 bit
2. RAM : 4 GB min. and expandable to 16 GB
3. Hard Drive : 500 GB or more
4. Removable bulk storage : DVD (R/RW)
5. Graphic accelerator : 8MB (minm.)
6. Graphic Memory : dedicated 1GB or better
7. Operating System : Windows 7 or better
8. Audio controller : 16 bit
9. Communication Port : 2 serial, one parallel, 8 USB, Dual 100Mbps Ethernet
10. Expansion Slot : 3
11. Cache : 512 KB Level 2
12. Video Card : PCI

b. MONITOR

1. Type : LCD COLOUR MONITOR
2. Screen Diagonal : 24" (approx.) flat
3. Display : XGA or better
4. Resolution : 1024 by 768 or better
5. Degree of Protection : IP-30
6. External Controls : Brightness, contrast, Horizontal/Vertical, amplification & Shift
7. Version : To suit Industrial application



Technical specification for
Computer
For
4X270 MW BHADRADRI TPS

SPEC NO.: PE-TS-411-145-I

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

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OF

c. KEY BOARD & MOUSE

1. Type : Flat spill proof membrane or positive depression type ASCII
2. Life Expectancy : 50 million cycles per key
3. Version : To suit Industrial application
4. Mouse : Optical mouse

d. SOFTWARE

Diagnostic Software, Anti Virus, Microsoft office, Acrobat Adobe Software and other application software.



Technical specification for
CONTROL & INSTRUMENTATION
4 X 270 MW BHADRADRI TPS

SPEC NO.: PE-TS-411-145-I

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

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OF

FURNITURE SPECIFICATION