

4.34/2020/PS-PEM-MSX P



DOCUMENT TITLE:

**TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT
BHUSAWAL TPS (1 X 660MW)**

BHEL DOCUMENTS NO.: PE-TS-415-164-A001

Volume: II

Section: IIC

REV. NO. 00

DATE:

GENERAL TECHNICAL REQUIREMENT (CONTROL & INSTRUMENTATION)

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION: C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
<u>TABLE OF CONTENTS</u> B. C&I deliverables list C. Specification for Motorized valve actuator D. Specification for field instruments E Specification for Local Control Panel F. Drive control philosophy G. Applicable codes and standards H. Specification for Quality assurance & Testing I. Mandatory spares J. Drawings		

C&I DELIVERABLES LIST

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT							
1X660 MW BHUSAWAL TPP							
DOCUMENT NUMBER PE-GL-415-145-I100							
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION							
1	PE-V9-415-XXX-I901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I	
2	PE-V9-415-XXX-I902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I	
3	PE-V9-415-XXX-I903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I	
4	PE-V9-415-XXX-I904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I	
5	PE-V9-415-XXX-I905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I	
6	PE-V9-415-XXX-I908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I	
7	PE-V9-415-XXX-I909	DCS INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I	
8	PE-V9-415-XXX-I913	CONTROL PANEL LAYOUT/ GA DRAWING	A	-	VENDOR	C&I	
9	PE-V9-415-XXX-I918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	-	VENDOR	C&I	
10	PE-V9-415-XXX-I919	PROCESS GRAPHIC MANUSCRIPTS FOR DCS	I	-	VENDOR	C&I	
11	PE-V9-415-XXX-I920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I	
12	PE-V9-415-XXX-I921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS (from Field to JB to DCS)	I	-	VENDOR	C&I	
13	PE-V9-415-XXX-I925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I	
	Notes:	415 - Project No.					
		XXX -MAX Package Code					
		\$\$ -Approval by BHEL if Vendor BBU Item. Approval by Customer if Customer BBU Item					

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	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR MOTORISED VALVE ACTUATOR		

 MAHAGENCO MAHARASHTRA STATE POWER GENERATION CO. LTD.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 11
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1.0	<u>SCOPE</u> 1.1 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates. 1.2 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. <u>2.0 STANDARDS</u> 2.1 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification. 2.2 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: (a) IS-9334 (b) IS-325 <u>3.0 SERVICE CONDITIONS</u> 3.1 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash. 3.2 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification. <u>4.0 RATING</u> 4.1 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer. 4.2 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.	

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5.0	<u>PERFORMANCE</u> The actuator shall meet the following performance requirements: 5.1 Open and close the valve completely and make leak-tight valve closure without jamming. 5.2 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect). 5.3 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat. 5.4 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. 5.5 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. 6.0 <u>SPECIFIC REQUIREMENT</u> 6.1 <u>CONSTRUCTION</u> 6.1.1 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. Actuator shall be integral type. Integral starter shall have facility to hook-up with Plant DCS for positioning of limit and torque switches. 6.1.2 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy. 6.1.3 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth. 6.1.4 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.	

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6.2	<u>MOTOR</u> 6.2.1 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. 6.2.2 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current. 6.2.3 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. 6.2.4 Earthing terminals shall be provided on either side of the motor. 6.3 <u>LIMIT SWITCHES</u> Each actuator shall be provided with following limit switches: 6.3.1 Two (2) torque limit switches, one for each direction of travel, self-locking, adjustable torque type. 6.3.2 Four (4) end-of-travel limit switches, two for each direction of travel. 6.3.3 Two (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. 6.3.4 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. 6.4 <u>HAND WHEEL</u> Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.	

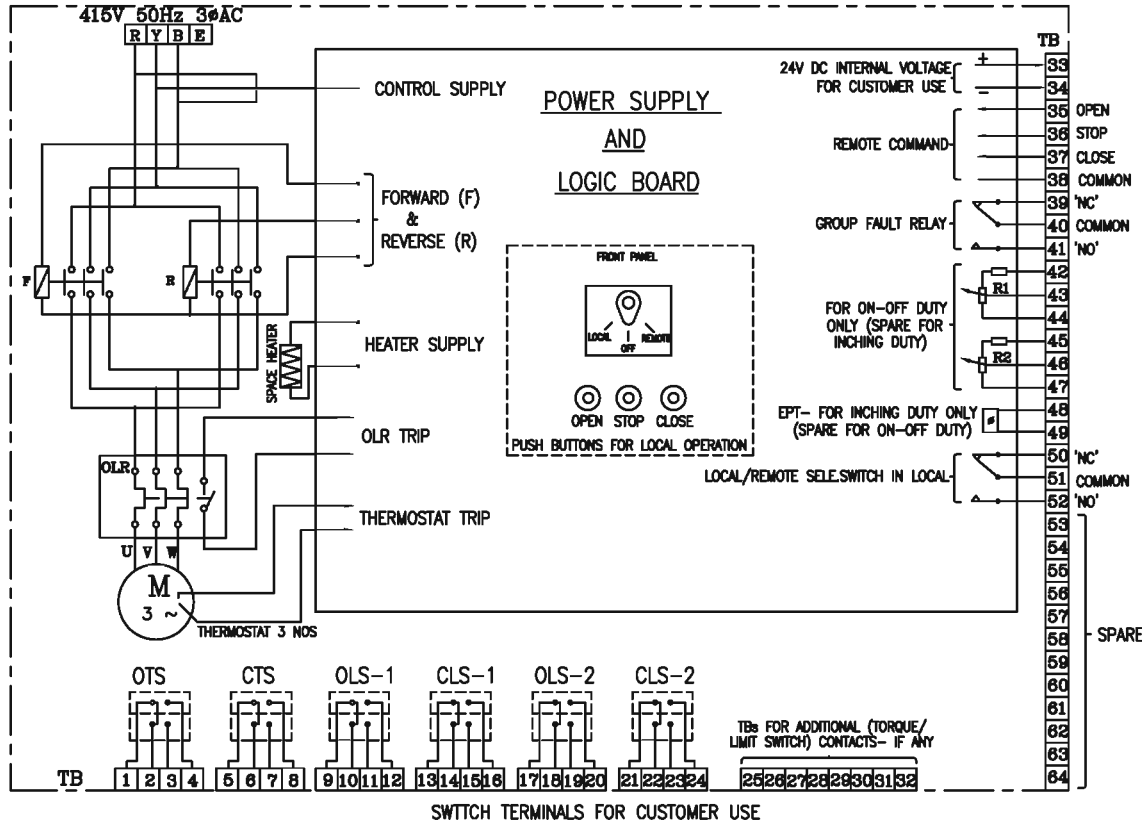
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6.5	<u>POSITION INDICATOR/TRANSMITTER</u> The actuator shall have: 6.5.1 One (1) built-in local position indicator for 0-100% travel 6.5.2 One (1) position transmitter, potentiometer type, for remote indicator. 6.6 <u>SPACE HEATER</u> A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply. 6.7 <u>WIRING</u> All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. 6.8 <u>TERMINAL BOX</u> 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. 7.0 <u>TEST</u> 7.1 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. 7.2 <u>TEST WITNESS:</u> Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.	

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

DRAWING NO. 3-V-MISC-24227



CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	
SWITCH	TERMINAL NO.	
	FULL OPEN	INTERMEDIATE FULL CLOSE
VALVE POSITION		
INDICATES CONTACT CLOSED		
INDICATES CONTACT OPEN		
CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC		

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#
# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT				
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)				

NOTE:-

- 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
- CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
- OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
- OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
- CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
- EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
- R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
- FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
- M - MOTOR 3Φ 415V 50 Hz AC SUPPLY

REV	DATE	ALTERED
		CHD & APPD

CAUTION: The information on this drawing 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.

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



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

DEPT	VL	SCALE	WEIGHT (KG).	REFERENCE INFORMATION	NO. OF
CODE					THIN
TITLE	WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER			DRAWING NO. 3-V-MISC-24227	REV 0
CARD CODE	U 01				

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	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR FIELD INSTRUMENTS		

22.00.00 SPECIFICATIONS OF EFFLUENT QUALITY MONITORING SYSTEM (EQMS)

22.01.00 COMMON REQUIREMENTS FOR ALL ANALYSERS

Sno	Features	Minimum Requirement
1.	Output signals	Analog 4-20 mA DC galvanically isolated.
2.	Zero & span Adjustment	To be provided with range selection facility
3.	Ambient temp	50 degC
4.	Sample Temperature	40 degC
5.	Indication	Digital Alphanumeric Display of reading in engineering units shall be provided.
6.	Type of Electronics	Microprocessor based with self-diagnostic
7.	Others	All interconnection tubing and cabling

		between sensor and analyzer / analyzer panel etc to be provided. All chemical reagents required for EQMS analyzers for entire AMS period is to be supplied in phased manner depending on shelf life.
8.	Location of the Temp & flow measurement	Effluent Treatment plant outlet (Exact location to be decided by contractor in consultation with site)
9.	Location of the Analyser cabinet/enclosure	
10	Accessories	All the accessories required for mounting the sensor/analyser are to be provided
11	Digital Signal Transmission	Each analyser shall have a provision for bidirectional soft connectivity over Modbus/RS232/RS485 with employer's central cloud server in addition to 4-20 ma connectivity to DDCMIS.
12	Compliance to standards	Latest regulatory requirements of CPCB/SPCB/other regulatory/statutory body prevailing at the time of award of the contract.

22.04.00**BOD BIOLOGICAL OXYGEN DEMAND / COD CHEMICAL OXYGEN DEMAND ANALYSER**

Principle	COD/BOD measurement by: Option A. Total Organic Carbon (TOC) measurement complying to US EPA 415.1 / 415.2 or equivalent standard for effluent/sewage/waste water. Option B. UV-VIS spectrometer measuring absorption in UV-VIS spectrum.
Measuring Range	0-50 mg/L for BOD, 0-500 mg/L for COD
Response Time	<= 15 min
Power	To be arranged by contractor
Cleaning	Self-cleaning (Automatic)
Accuracy	+/- 3%

22.06.00**TOTAL SUSPENDED SOLIDS – TSS ANALYSER**

Principle	Light reflection principle
Measuring Range	0-500 mg/l
Response Time	<= 5 min
Power	To be arranged by bidder (Refer terminal point)
Cleaning	Self-cleaning (Automatic)
Accuracy	+/- 5%

22.07.00**ENCLOSURE/CABINETS / PANELS FOR EQMS AND ANALYSERS**

The enclosure shall accommodate all EQMS Analyzers. The enclosure of all analyzers shall provide protection from dust, humidity, precipitations, sunlight and environmental pollution. The material for the enclosure shall be of steel plate (SS304) with minimum 2 mm thick frame and minimum 2 mm thick steel (SS-304)

sheet of protection IP 65 or better with safety lock of good quality. The lighting provision in the cabinet is to be provided. The cabinets shall be designed such that the wet section and dry section are separate, the exact details shall be finalized during detailed engineering. The panel shall be free standing type constructed of suitable 3 mm thick channel frame of SS and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack.

In order to ensure the healthy operation of the installed electronic modules, cards, analyzers, etc inside the enclosure during continuous operation, the EQMS enclosure shall be provided with Air conditioner unit.

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5.1 CONDUCTIVITY ANALYZER		
5.1.1 Sensor		
(a)	Type of Cell	: Flow thru'.
(b)	Conductivity Range	: As per instrument schedule
(c)	Cell Constant	: 0.01/0.1/1.0 depending upon range.
(d)	Temp. Compensation	: Manual and Automatic (Integral) 0-100°C.
(e)	Process Connection	: Screwed.
(f)	Wetted Parts	: Electrodes-SS316L/ Insulators KYNAR/Viton.
(g)	Pressure Rating	: 10 kg/cm ² .
(h)	Accessories	: Vessel (SS 316) with ½" NPT connection.
(i)	Cable	: Upto transmitter in flexible conduct.
5.1.2 Transmitter		
(a)	Type	: Microprocessor based, Single stream
(b)	Mounting	: Flush Panel.
(c)	Protection Class	: IP-55 or better.
(d)	Output	: 4-20 mA DC (isolated).
(e)	Display	: Digital Display in Engineering Unit, Alarm Status.
(f)	Zero/Span Adjustment	: Front Panel Membrane type

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Keyboard. (g) Temp. Compensation : Manual or Automatic. (h) Diagnostic : Self diagnostic for electronics, electrode etc. (i) Alarm : Dual set point, hysteresis and time delay adjustable. (j) Enclosure : Die cast aluminium, epoxy coated. (k) Cable Termination : Internal (cable entry through conduit). (l) Accuracy : ± 1.0 % of measured range. (m) Response time : Less than 5 sec. (n) Stability : ± 1.0 % of output range / month non-cumulative. (o) Accessories : For cation conductivity- Dual Ion-Exchange column, resin, etc. (minimum 12 months' requirements). 5.2 <u>pH ANALYZER</u> : 5.2.1 Sensor : (a) Type of Cell : Flow thru'. (b) Range : 0-14 pH. (c) Type of measurement : Combination electrode. (d) Temp. Compensation : Manual and Automatic (Integral) 0-100 °C.		

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(e) Process Connection : Screwed. (f) Measuring Electrode : Glass. (g) Pressure Rating : 10 kg/cm². (h) Accessories : Vessel (SS 316) with ½" NPT connection. (i) Cable : Upto transmitter in flexible conduct. (j) Preamplifier : Integral or separate. (k) Liquid Junction : Ceramic / Kyner or equivalent. 5.2.2 Transmitter : (a) Type : Microprocessor based, Single stream (b) Mounting : Flush Panel. (c) Protection Class : IP-55 or better. (d) Output : 4-20 mA DC (isolated). (e) Display : Digital Display in Engineering Unit, Alarm Status. (f) Repeatability : ± 1% or better. (g) Temp. Compensation : Manual or Automatic. (h) Diagnostic : Self diagnostic for "Calibration requiried"/ "Calibration O.K.", electrode checking etc. (i) Alarm : Dual set point, hysteresis and time delay adjustable.		

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	(j) Enclosure : Die cast aluminium, epoxy coated. (k) Cable Termination : Internal (cable entry through conduit). (l) Accuracy : $\pm 0.2\%$ of FSD or better. (m) Response time : Less than 5 sec. (n) Stability : ± 0.001 pH /week. (o) Accessories : Ultrasonic Electrode Cleaner, Buffer solution tablets.	
5.3	<u>SILICA ANALYZER</u> : (a) Type : Colorimetric monitor, gravity / pumped feed Microprocessor based. (b) Output : 4-20 mA DC (isolated) into 600 ohms. (c) Readout : Digital Indicating meter for direct readout. (d) Accuracy : $\pm 1\%$ of F.S.D or better. (e) Reproducibility : $\pm 2\%$ of F.S.D. or better. (f) Calibration : Manual & automatic. (g) Cycle time : Less than 10 min or better. (h) Operating temperature : 0-45 °C . (i) Mounting : Flush panel. (j) Life of light source : 9,000 hours (approx.).	

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SR. NO.	ITEM	DESCRIPTION	
1.0	<u>FIELD INSTRUMENTS</u>		
	This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.		
1.1	<u>PRESSURE TRANSMITTER</u>		
1.1.1	Working Principle	SMART, HART Protocol.	
1.1.2	Type	2 – Wire.	
1.1.3	Output Signal	4-20 mA DC.	
1.1.4	Signal Processing	Silicon solid state electronic circuitry.	
1.1.5	Measuring Element	Capsule/Diaphragm.	
1.1.6	Element material	AISI-316 (Stainless Steel) or better.	
1.1.7	Static Pressure	150 % of maximum span continuously, without affecting the calibration.	
1.1.8	Turn-down ratio	100:1	
1.1.9	Span and Zero	Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span.	
1.1.10	Enclosure Class	IP-65.	
1.1.11	Output Indicator	LCD Type.	
1.1.12	Nameplate	Tag number, service engraved in SS tag plate.	
1.1.13	Body	Forged Carbon Steel for air and flue gas application and SS for other	

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SR. NO.	ITEM	DESCRIPTION	
		application.	
1.1.14	Operating Voltage	16 - 48 Volts D.C.	
1.1.15	Load	600 Ohms (min.) at 24 Volts D.C.	
1.1.16	Ambient Temperature	0 - 50 °C.	
1.1.17	Performance :		
	(a) Accuracy	± 0.1% of Span or better.	
	(b) Repeatability	± 0.05% of Span or better.	
	(c) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (g)	
1.1.18	Sealing/Isolation	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.	
1.1.19	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 2-valve stainless steel manifold, constructed from SS316 bar stock.	

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SR. NO.	ITEM	DESCRIPTION	
		(e) Companion flange with nuts, bolts and gaskets.	
		(f) Hand held configuration kit for calibration of SMART Transmitter.	
		(g) ½" NPT cable gland.	
1.2	<u>DIFFERENTIAL PRESSURE TRANSMITTER/FLOW TRANSMITTER</u>		
1.2.1	Working Principle	SMART, HART Protocol.	
1.2.2	Type	2-Wire.	
1.2.3	Output signal	4-20 mA DC.	
1.2.4	Signal Processing Unit	Silicon solid-state electronic circuitry.	
1.2.5	Measuring element	Capsule/Diaphragm.	
1.2.6	Element material	AISI-316 (Stainless Steel) or better.	
1.2.7	Static Pressure/Overload Pressure	Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy.	
1.2.8	Turn-down ratio	100 : 1 minimum.	
1.2.9	Span and Zero	Locally adjustable, non-interacting.	
1.2.10	Enclosure class	IP-65.	
1.2.11	Zero suppression/elevation	At least 100% of Span.	
1.2.12	Output Indicator	LCD Type.	
1.2.13	Nameplate	Tag number and Service engraved in SS tag plate.	

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1.2.14	Body	Forged Carbon Steel for air and flue gas application and SS for other application.	
1.2.15	Ambient temperature	0 - 50 °C.	
1.2.16	Operating Voltage	16 - 48 Volts DC.	
1.2.17	Load	600 Ohms (min.) at 24 Volts DC.	
1.2.18	Performance:		
	(a) Accuracy	±0.1 % of span or better.	
	(b) Repeatability	± 0.05 % of span or better.	
	(c) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (g)	
1.2.19	Sealing / Isolation	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.	
1.2.20	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) Companion flange with nuts, bolts and gaskets.	

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		(e) Hand held configurator kit for calibration of SMART Transmitter	
		(f) ½" NPT cable gland.	
		(g) ½" NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.	
1.3	<u>DISPLACER TYPE LEVEL TRANSMITTERS</u>		
1.3.1	Type	SMART, HART Protocol.	
1.3.2	Stages of operation	Continuous.	
1.3.3	Material -		
(a)	Displacer	AISI 316 SS.	
(b)	Suspension wire	AISI 316 SS.	
(c)	Torque tube housing	Carbon steel or SS as per application.	
(d)	Torque tube	Inconel.	
(e)	Displacer chamber	CS or SS as per process application.	
(f)	Transmitter Housing	Die cast Aluminium or better.	
1.3.4	Operating Voltage	16-48 Volts D.C.	
1.3.5	Transmission	2-wire.	
1.3.6	Output Signal	4-20 mA DC.	
1.3.7	Signal processing	Solid-state electronic circuitry.	

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1.3.8	Static / overload pressure	Maximum static pressure without permanent deformation or loss of accuracy.	
1.3.9	Turn-down ratio	10 : 1 or better.	
1.3.10	Zero & Span	Easily accessible (local zero & span adjustment and non-interactive type).	
1.3.11	Enclosure Class	IP-65.	
1.3.12	Output Indicator	LCD type.	
1.3.13	Nameplate	Tag number and Service engraved in stainless steel tag plate.	
1.3.14	Ambient Temperature	0 - 50° C.	
1.3.15	Load Impedance	600 Ohms at 24 Volts (minimum).	
1.3.16	Process Connection	2" Companion flange with nuts, bolts and gaskets.	
1.3.17	Performance -		
	(a) Accuracy	±0.5 % of span or better.	
	(b) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (g)	
1.3.18	Accessories	(a) Counter Flange, nuts, bolts, gaskets etc.	

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		(b) Weights for 5 point calibration of instruments.	
		(c) Vent and drain plugs.	
		(d) Special calibration tool / configuration, if any.	
		(e) ½"NPT cable gland.	
1.3.19	Preferred Features	(a) Test plug connection and cutout terminals physically separated from other electronics.	
		(b) Electronic Damping facility (adjustable).	
1.4	<u>MASS FLOW METER</u>		
1.4.1	Sensor		
1.4.1.1	Measuring Principle	Coriolis Mass flow.	
1.4.1.2	Primary Element	Flow Tube of 316SS or better.	
1.4.1.3	Heating Arrangement	Integral.	
1.4.1.4	Temperature Control	For heavy fuel oil application.	
1.4.1.5	Process Connection	Flanged of rating as per process requirement.	
1.4.1.6	Drain	Self-draining facility.	
1.4.1.7	Enclosure	Stainless steel.	
1.4.1.8	Accessories	Counter flanges, Mounting nuts, bolts, gaskets etc.	
1.4.2	Transmitter		

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1.4.2.1	Measured quantities	Mass Flow rate, Total Mass Flow, Density, Temperature.	
1.4.2.2	Input Signal Processing	Digital Processing.	
1.4.2.3	Display	Digital Display LCD Type.	
1.4.2.4	Output	2 off isolated 4-20mA DC output.	
1.4.2.5	Load	< 750 ohms.	
1.4.2.6	Power supply	240V AC, 50 Hz.	
1.4.2.7	Turn Down	100:1.	
1.4.2.8	Accuracy	± 0.2 % of measured value.	
1.4.2.9	Housing	IP 65.	
1.4.2.10	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.4.2.11	Accessories	(a) Handheld configurator.	
		(b) Mounting U-bolts, nuts, bolts, prefab cable etc.	
		(c) ½"NPT cable gland.	
1.5	<u>SOLID FLOW METER</u>		
1.5.1	TYPE	On-line Impact type microprocessor based.	
1.5.2	Measuring Principle	The system measurement basically pertains to the measurement of horizontal deflection using LVDT, created by the impact of Solid flow upon on-line sensing plate. The horizontal deflection being	

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		engineering units or 0-100%	
1.6.10	Output	2 off isolated 4-20mA DC output	
1.6.11	Load	< 750 ohms.	
1.6.12	Power supply	240V AC, 50 Hz.	
1.6.13	Turn Down	100:1.	
1.6.14	Accuracy	± 0.2 % of measured value.	
1.6.15	Enclosure	NEMA4X (IP67) aluminum, Epoxy coated	
1.6.16	Nameplate	Tag number, service engraved in stainless steel tag plate.	
	Notes:		
1.	The above on-line flow meter shall not create any obstruction on flow.		
2.	Users’ list shall be submitted to support on proven satisfactory performance for similar process applications.		
1.7	<u>PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE</u>		
1.7.1	Type	Bourdon / Bellows / Diaphragm.	
1.7.2	Sensing & Socket	AISI-316 SS.	
1.7.3	Movement Material	AISI-304 SS.	
1.7.4	Case Material	Stainless steel, IP-65.	
1.7.5	Dial Size	Generally 150 mm.	
1.7.6	Scale	Black lettering on white in 270 ° arc.	

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1.7.7	Window	Shatterproof glass.	
1.7.8	Range Selection	Normal process pressure: 50~70% of range.	
1.7.9	Over-range Protection	125% of maximum range by internal stop. External stop at zero.	
1.7.10	Adjustment	Micrometer screw for zero. Internal micrometer screw for range.	
1.7.11	Element Connection	Argon welding.	
1.7.12	Process Connection	1/2" NPT(M) Bottom for local, back for panel mounting.	
1.7.13	Performance	Accuracy of ± 1.0 % of span or better.	
1.7.14	Operating ambient	0 - 50 °C.	
1.7.15	Safety Feature	Blow out disc /diaphragm at the back.	
1.7.16	Accessories	(a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.	
		(b) Stainless steel Diaphragm seals for viscous fluids	
		(c) 3-Way SS316 Gauge cock for pressure gauges.	
		(d) 5-valve SS316 manifold from barstock for differential pressure gauge.	
		(e) Siphons for steam and hot water services.	

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1.7.17	Applicable standard	IS-3624 / 1996.	
1.7.18	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.8	<u>TEMPERATURE GAUGE</u>		
1.8.1	Type	Mercury or gas filled.	
1.8.2	Sensing Element Material	Bourdon - AISI-316 SS.	
1.8.3	Capillary Armoring	Stainless steel flexible.	
1.8.4	Movement Material	AISI 304 SS.	
1.8.5	Bulb / Stem Diameter	12 mm.	
1.8.6	Bulb / Stem Material	AISI 316.	
1.8.7	Capillary	Stainless Steel.	
1.8.8	Connection to well	½" NPT.	
1.8.9	Case Material	Stainless steel.	
1.8.10	Dial Size	150 mm in general.	
1.8.11	Scale	Black lettering on white in 270 ° arc.	
1.8.12	Mounting	Surface/Panel.	
1.8.13	Over range Protection	125 % of range or more.	
1.8.14	Instrument connection	Bottom for local and back for panel mounting.	
1.8.15	Range	Normal temperature – 50~70% of range.	
1.8.16	Zero adjuster	Micrometer screw adjustable from front.	

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1.8.17	Window	Shatterproof glass.	
1.8.18	Accuracy	± 1 % or better.	
1.8.19	Enclosure Class	IP-65.	
1.8.20	Capillary	5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel.	
1.8.21	Compensation	Capillary and Case Compensation.	
1.8.22	Accessories	(a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of Thermowell: (i) SS 316: In general. (ii) Inconel: For flue gas application. (iii) Tungsten carbide: For coal mill application.	
1.8.23	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.9	<u>THERMOCOUPLES</u>		
1.9.1	Type	(a) Type-J (Iron Constantan) / Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.). [As per application]	
		(b) Duplex.	
		(c) Ungrounded.	

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		thermowells.	
1.9.8	Accessories	(a) Adjustable nipple-union-nipple (½", Sch 80 x ½" NPT M) with thermowell connection.	
		(b) Compression fittings/unions.	
		(c) Flanges etc. (for flanged connections only).	
		(d) Forged barstock thermowell as per ASME PTC code. Process connection M 33 x 2 (M) in general or 1½" Flanged for Flue gas / Furnace / Air etc. application. Material of construction of Thermowell: SS 316 : In general Inconel: For flue gas application Tungsten carbide : For coal mill application.	
1.9.9	Name plate	Tag number, service engraved in stainless steel tag plate.	
1.10	<u>RESISTANCE TEMPERATURE DETECTOR</u>		
1.10.1	Type	Platinum (Duplex), Ungrounded.	
1.10.2	Resistance	100 ohm at 0 °C.	
1.10.3	Base	Wound on ceramic (anti-inductive).	
1.10.4	Wiring	3 / 4 Wire.	

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1.10.5	Protecting Tube		
(a)	O.D.	8 mm.	
(b)	Material	SS-316, Seamless.	
(c)	Filling	Magnesium oxide (Purity above 99.4%).	
1.10.6	Response time	(a) < 20 seconds for measurement.	
		(b) < 10 seconds for control.	
1.10.7	Calibration	DIN 43760.	
1.10.8	Accuracy	± 0.5%.	
1.10.9	Head:		
(a)	Type	IP-65 universal screwed type.	
(b)	Material	Die cast aluminium or better.	
(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. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells.	
1.10.10	Accessories	(a) Adjustable nipple-union-nipple (½" Sch 80 x ½" NPT M) with Thermowell connection.	

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		(b) Compression fittings / unions.	
		(c) Flanges etc. (for flanged connections only)	
		(d) Forged / barstock Thermowell as per ASME PTC code. Process connection M33 x 2 (M). Material of construction of Thermowell: SS 316: In general. Inconel: For flue gas application. Tungsten carbide: For coal mill application.	
1.10.11	Name plate	Tag number, service engraved in stainless steel tag plate	
1.11	<u>PRESSURE SWITCH</u>		
1.11.1	Type	(a) Piston for high pressure application.	
		(b) Bellow / Diaphragm for low pressure application.	
1.11.2	Sensing element material	AISI SS-316. All other wetted part SS316.	
1.11.3	Case Material	Die-cast aluminium alloy, neoprene gasket.	
1.11.4	Setter Scale	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.	

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1.11.5	Over range	150 % of maximum pressure.	
1.11.6	Adjustments	(a) Internal Set Point.	
		(b) Differential adjustment.	
1.11.7	End Connection	½" NPT (M) bottom connected.	
1.11.8	Switch configuration	Two SPDT.	
1.11.9	Switch Rating	240V, 5A AC / 220V, 0.5A DC.	
1.11.10	Switch Type	Snap acting, hermetically sealed, shock & vibration proof.	
1.11.11	Terminal Block	Suitable for full ring lugs.	
1.11.12	Cable connection	½" NPT conduit connection.	
1.11.13	Enclosure Class	IP-65.	
1.11.14	Performance	(a) Repeat accuracy $\pm 1.0\%$.	
		(b) Accuracy of Setting Indication of $\pm 1.5\%$.	
1.11.15	Ambient temperature	0 – 50 Deg C.	
1.11.16	Nameplate	Tag number, service engraved in SS tag plate.	
1.11.17	Accessories	(a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application.	
		(b) Siphons for steam and hot water services.	
		(c) Retention ring and screws for surface mounting.	

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		(d) 1/2" NPT 2 Valve SS-316 barstock manifold.	
		(e) 1/2" NPT cable gland.	
1.12	<u>DIFFERENTIAL PRESSURE SWITCH</u>		
1.12.1	Type	Bellows/Diaphragm/Piston actuated.	
1.12.2	Sensing element material	AISI SS-316. For all other wetted part SS 316.	
1.12.3	Case Material	Die-cast aluminium alloy with neoprene gasket.	
1.12.4	Setter Scale	Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment.	
1.12.5	Over range	Static pressure on any one side, the other side being open to atmosphere.	
1.12.6	Adjustments	(a) Internal set point adjustment.	
		(b) Differential adjustment.	
1.12.7	Process Connection	1/2" NPT (M) bottom / back connected.	
1.12.8	Switch configuration	Two SPDT.	
1.12.9	Switch rating	240V, 5A AC/220V, 0.5A DC.	
1.12.10	Switch type	Snap acting type contacts, shock and vibration proof.	
1.12.11	Terminal Blocks	Suitable for full ring lugs for cable	

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		connection.	
1.12.12	Cable Connection	½" NPT conduit connection or compression gland.	
1.12.13	Performance	(a) Repeat accuracy $\pm 1.0\%$.	
		(b) Accuracy of set point Indication: $\pm 1.5\%$	
1.12.14	Operating Ambient	0 - 50 °C (Maximum Continuous).	
1.12.15	Enclosure	IP-65.	
1.12.16	Accessories	(a) Snubbers for pulsating fluid application.	
		(b) Syphons for steam and hot water services.	
		(c) Retention ring and screws for surface mounting.	
		(d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock.	
		(e) 1/2" NPT Cable gland.	
1.12.17	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.12.18	Remote Seal type for special application	(a) Silicone oil/fluorolube filled remote diaphragm seal for dirty/viscous/corrosive fluid.	
		(b) SS armoured capillary at least 3 meters each.	

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		(c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.	
1.13	<u>LEVEL SWITCH</u>		
1.13.1	Type	External cage float operated. Magnetically coupled.	
1.13.2	Float Material	AISI-316 stainless steel or better.	
1.13.3	Other wetted parts	AISI-316 stainless steel or better.	
1.13.4	External Cage	Carbon steel/Stainless steel as per process requirements, welded type/flanged construction. Cage pressure rating shall equal or exceed the rating of the main vessel.	
1.13.5	External cage mounting	Side-Side.	
1.13.6	External cage connection	25 NB socket welded.	
1.13.7	Switch housing	Epoxy coated die-cast aluminium alloy with neoprene gasket conforming to IP-65.	
1.13.8	Type of switch configuration	2 SPDT (two nos.).	
1.13.9	Contact rating	5A, 240V/AC, 0.25A, 220V DC.	
1.13.10	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	

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		alpha-numeric engraved for service and tag.	
1.13.11	Preferred feature	Switch operating point marked on cage.	
1.13.12	Mounting	On standpipe.	
1.14	<u>CONDUCTIVITY TYPE LEVEL SWITCH</u>		
1.14.1	Type	Conductivity discrimination.	
1.14.2	Application	Drain pots viz. on CRH line.	
1.14.3	Mounting	Flanged – on external cage.	
1.14.4	Probe MOC	Stainless steel with high purity ceramic.	
1.14.5	Probe rating	> Maximum design pressure of vessel.	
1.14.6	Input	Four independent channel with selectable switching threshold for water conductivity.	
1.14.7	Relay Output	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.	
1.14.8	Contact type & rating	2 SPDT or 1 DPDT @ 5A 30V DC.	
1.14.9	Local Display	Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.	
1.14.10	Power supply	Dual 240V AC, 50 Hz, 1Ph.	
1.14.11	Enclosure	IP-65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).	

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1.14.12	Accessories	(a) PTFE cable from probe to electronics.	
		(b) Mounting accessories.	
		(c) External cage.	
		(d) Washer & gasket.	
1.14.13	Test pressure	(e) Two times rated pressure.	
1.14.14	Cable connection	(f) ½" NPT with cable gland.	
1.15	<u>CONDUCTIVITY TYPE ELECTRONIC LEVEL INDICATOR</u>		
1.15.1	Type	Conductivity discrimination.	
1.15.2	Application	HP heater level.	
1.15.3	No. of Probes	10	
1.15.4	Probe Mounting	Flanged – on standpipe.	
1.15.5	Probe MOC	Stainless steel with high purity ceramic.	
1.15.6	Probe rating	> Maximum design pressure of vessel.	
1.15.7	Input	Independent channel with selectable switching threshold for water conductivity.	
1.15.8	Relay Output	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.	
1.15.9	Contact type & rating	2 SPDT or 1 DPDT @ 5A 30V DC.	

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1.15.10	Current output	Isolated 4-20 mA DC.	
1.15.11	Local Display	(a) Coloured (Red & Green) LEDs for level.	
		(b) Flashing LEDs for fault.	
1.15.12	Remote Display	Red, Green & flashing yellow LEDs for steam, Water & Fault indication respectively.	
1.15.13	Power supply	Dual 240V AC, 50 Hz, 1Ph.	
1.15.14	Enclosure	(a) IP-65, corrosion resistant & wall mounting type for local electronics.	
		(b) IP-42 for remote indicator.	
1.15.15	Accessories	(a) PTFE cable from probe to electronics.	
		(b) Mounting accessories.	
		(c) Standpipe.	
		(d) Washer & gaskets.	
		(e) Double isolation valves on each connection, double drain valves & double vent valves with mechanical lock.	
		(f) ½" NPT cable gland.	
1.15.16	Test pressure	Two times design pressure.	
1.16	<u>ORIFICE PLATE</u>		

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1.16.1	Application	Low fluid velocity flow measurement.	
1.16.2	Design Standard	BS-1042, Part-I.	
1.16.3	Number of Tapings	As required plus one additional pair of taps.	
1.16.4	Diameter Ratio	Between 0.4 to 0.7.	
1.16.5	Thickness	3 mm for main pipe diameter upto 250 mm, 6 mm for main pipe diameter above 250 mm and upto 500 mm and 10 mm for main pipe diameter of 500 mm and above.	
1.16.6	Document	Beta ratio calculation, assembly drawing and Flow vs. DP curve.	
1.16.7	Meter run pipe	Same as pipe material.	
1.16.8	Accessories	Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc.	
1.17	<u>FLOW NOZZLE</u>		
1.17.1	Application	High fluid velocity flow measurement.	
1.17.2	Design Standard	ASME PTC 19.5.	
1.17.3	Number of Tapings	As required plus one additional pair of taps.	
1.17.4	Diameter Ratio	Between 0.4 and 0.7.	
1.17.5	Thickness	Suitable for the application.	
1.17.6	Document	Beta ratio calculation, assembly	

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		drawing and Flow vs. DP curve.	
1.17.7	Meter run pipe	Same as pipe material.	
1.17.8	Accessories	Meter run pipe, nipples and root valves (Inspection port assembly for nozzles used in plant performance purpose).	
1.18	<u>GAUGE GLASS</u>		
1.18.1	Type	Reflex.	
1.18.2	Glass	Toughened borosilicate Resistant to mechanical and thermal shocks.	
1.18.3	Body material	Carbon steel / stainless steel - As per process requirements (Flanged Connection).	
1.18.4	Pressure rating	Twice the maximum working pressure.	
1.18.5	Temperature rating	As required.	
1.18.6	Bolts and nuts	Rust proof alloy steel.	
1.18.7	Accessories	Suitable ball check valves of SS-304 /316 body, gaskets, companion flange etc.	
1.19	<u>POWER CYLINDERS (PNEUMATIC)</u>		
1.19.1	Mounting Type	(a) Fixed position mounting. (End mounting)	
		(b) Trunnion mounting.	
1.19.2	Control Signal	4-20 mA DC to SMART positioner with Superimposed HART protocol for	

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1.25.16	Enclosure	Flame Proof.	
1.25.17	Accessories	Calibration gas, mounting accessories and others as required to be provided	
1.25.18	Application	Generator Gas Purity.	
1.26	<u>RADAR TYPE LEVEL MEASUREMENT</u>		
1.26.1	Type	Radar based on Time Domain Reflectometry.	
1.26.2	Antenna	Co axial / single rod type guided wave or Horn type as required for the application.	
1.26.3	Communication	Two wire 4-20mA DC, HART protocol.	
1.26.4	Environmental temperature	0 – 50 °C.	
1.26.5	Enclosure	Explosion proof/IP 65 as per application.	
1.26.6	Cable Entry	½" NPT.	
1.26.7	Calibration	Self calibration with internal reference.	
		Zero & Span calibration.	
1.26.8	Programming	Handheld programmer & Local keypad.	
1.26.9	Process Connection	Flanged /screwed.	
1.26.10	Electronic Housing	Epoxy painted Die-Cast aluminium alloy.	

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1.26.11	Antenna / Flange assembly	316 SS or Hest alloy. (as required)	
1.26.12	Output Indicator	Digital Integral Display.	
1.26.13	Accuracy	5 mm or 0.1% of probe length.	
1.26.14	Accessories	(a) Programming tool kit.	
		(b) Gasket.	
1.27	<u>ULTRASONIC LEVEL TRANSMITTER</u>		
1.27.1	Principle of operation	Detection of reflected ultrasonic pulse, HART Protocol	
1.27.2	Measuring ranges	Up to 30 meters (typical)	
1.27.3	Signal processing	Microprocessor Controlled Signal Processing	
1.27.4	Operating frequency	10 KHz to 50 KHz (typical)	
1.27.5	Display	Large alpha-numeric back lit LCD/ LED	
1.27.6	Calibration & Configuration	Accessible from front of panel	
1.27.7	Diagnosis	On-line	
1.27.8	Status	For power, Hi/Lo/V. Hi/V. Lo - level indication, fault etc.	
1.27.9	Construction	Plug-on board	
1.27.10	Power supply	240 V AC 50 Hz / 24V DC	
1.27.11	Signal Output	4-20 mA DC - 600 Ohm load.	

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1.27.12	Hysteresis	Fully adjustable preferred	
1.27.13	Output contacts	2 SPDT Potential free changeover contacts @ 240V, 5A AC/220V, 0.5A DC.	
1.27.14	Accuracy & Repeatability	0.25% of span or better	
1.27.15	Resolution	0.1% of span	
1.27.16	Operating Temperature	Transmitter- 50 °C and Sensor – 80 °C	
1.27.17	MOC Sensor	Body- PVC and Face – Polyurethane	
1.27.18	Humidity	1% to 95% non condensing.	
1.27.19	Enclosure	IP-65 Epoxy painted die cast aluminium or Polycarbonate housing.	
1.27.20	Cable connection	3/4" ET	
1.27.21	Mounting	2" for sensor and Transmitter on panel.	
1.27.22	Accessories	Cable gland, prefab cable, mounting accessories.	
1.28	<u>CAPACITANCE TYPE LEVEL SWITCH</u>		
1.28.1	Type	Capacitance type	
1.28.2	Probe	(i) Rod or suspended electrode	
		(ii) Rope type probes may be used only where required probe length is greater than 3 meters.	
1.28.3	Probe Mounting	Stainless steel 1½" ANSI RF Flange / ¾" NPT (M)	

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1.28.4	Material of construction	316 SS	
1.28.5	Insulation	PTFE Part/ Full as per service.	
1.28.6	Enclosure	Powder/Epoxy coated Die cast aluminium with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).	
1.28.7	Ambient temperature	0-60 °C.	
1.28.8	Mounting	On Tap	
1.28.9	Supply voltage	240V AC, 50Hz /24V DC	
1.28.10	Relay output	2 SPDT	
1.28.11	Contact rating	240V, 5A AC/220V, 0.5A DC.	
1.28.12	Response time	100 mSec or better	
1.28.13	Cable connection	¾" ET	
1.28.14	Accessories	Counter flange, Cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.	
1.29	<u>TEMPERATURE SWITCH</u>		
1.29.1	Type	Mercury filled-in.	
1.29.2	Sensing Element Material	Bellow / Bourdon AISI SS-316.	
1.29.3	Bulb Material	AISI SS-316.	
1.29.4	Capillary	Stainless steel armoured.	
1.29.5	Movement Material	AISI SS-304.	
1.29.6	Case material	Epoxy coated steel plate or die-cast aluminium alloy with neoprene gasket	

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		and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).	
1.29.7	Scale	Black lettering on white background.	
1.29.8	Over range Protection	120 %.	
1.29.9	Instrument connection	Bottom.	
1.29.10	Switch configuration	Two SPDT.	
1.29.11	Switch rating	240V, 5A AC/220V, 0.5A DC.	
1.29.12	Switch type	Snap acting, shock and vibration-proof.	
1.29.13	Adjustability	Internal Set point adjustable over span range.	
1.29.14	Cable connection	3/4" ET conduit connection or compression gland.	
1.29.15	Compensation	(a) Capillary compensation with invar wire throughout the capillary length.	
		(b) Case compensation.	
1.29.16	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.	
1.29.17	Capillary length	5 meters (minimum) for local mounting/15 meters for local panel mounting.	

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1.29.18	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.29.19	Accessories	Mounting accessories, 3/4"ETcable gland.	
1.30	<u>ROTAMETER</u>		
1.30.1	Type	On-line up to 2". By-pass above 2".	
1.30.2	Metering tube	Borosilicate glass.	
1.30.3	Float	AISI 316-SS unless the process fluid demands some other material.	
1.30.4	Body MOC	AISI 316-SS.	
1.30.5	Scale	Graduated- Engraved black on white background.	
1.30.6	Process connection	Flanged.	
1.30.7	Accuracy	$\pm 2\%$ of full scale detection or better for on-line type and $\pm 4\%$ of full-scale detection or better for by-pass type.	
1.30.8	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.30.9	Accessories	Slip-on orifice plate of 316-SS and taps of Stainless Steel as per application requirements. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.	
1.31	<u>TURBIDITY ANALYSER</u>		
1.31.1	Type	Microprocessor based continuous	

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		turbidity monitoring system	
1.31.2	Wetted parts	Stainless Steel	
1.31.3	Insulation Assembly	Yes	
1.31.4	Range	As per service application	
1.31.5	Accuracy	Better than ± 3 % of full scale	
1.31.6	Sensitivity	Measures suspended solids from 0.001 to 10,000 NTU	
1.31.7	Analyser output	4-20 mA DC – Two (2) numbers and contacts	
1.31.8	Transmitter display	Digital	
1.31.9	Type of Switch	Snap acting	
1.31.10	Switch Rating	2 NO + 2NC, SPDT, Electrically isolated 240 V AC/5A,	
1.31.11	Power supply	24V DC (for 2 wire type) & 240 V AC (for 4-wire type)	
1.31.12	Calibration	Auto & Manual (from Remote)	
1.31.13	Transmitter Housing	Die cast aluminium weather proof, dust tight & water proof conforming IP 65. For hazardous area, Explosion proof Enclosure as described in NEC article 500.	
1.32	<u>CHLORINE LEAK DETECTOR</u>		
1.32.1	Sensor Type	Electro Chemical	
1.32.2	Resolution	0.1 ppm	

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1.32.3	Response Time	Less than 1 second	
1.32.4	Display Type	7 Segment LED Display , Minimum 3 Digits with Decimal Point indications , Minimum Digit Height 12.5 mm	
1.32.5	Alarm Type	Industrial Hooter	
1.32.6	Power Supply	240 V , 50 Hz , AC, 1 Phase	
1.32.7	Output	4 to 20 mA DC	
1.32.8	Alarm Output	1NO + 1NC PF contact rated at 240V AC 5A	
1.32.9	Enclosure	Epoxy painted die cast aluminium, IP 67.	
1.32.10	Mounting	Wall Mounting with all mounting accessories	
1.33	NUCLEONIC TYPE DENSITY METER		
1.33.1	Type	Nucleonic type	
1.33.2	Measurement range	About 1.5 times normal density (min.)	
1.33.3	Accuracy	± 0.1% of span.	
1.33.4	Enclosure	IP 65	
1.33.5	Power supply	24 V DC / 230 V AC	
1.33.6	Output	(i) 4 –20 mA DC	
		(ii) 2 SPDT or 1 DPDT @ 5A, 30 VDC.	

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1.33.7	Local indication	Required	
1.33.8	Radioactive source	Radioactive source with regulatory approval for handling to be used.	
1.33.9	Mounting	On vessel with suitable mounting accessories.	
1.34	<u>NON-NUCLEONIC TYPE</u> <u>DENSITY METER</u>		
1.34.1	Type	Vibration of pendulum/ Rod	
1.34.2	Range	To suit the process.	
1.34.3	Temperature correction required	Yes/No	
1.34.4	Accuracy	± 1%	
1.34.5	Response time	Less than 1minute	
1.34.6	Sensor material	SS 316	
1.34.7	Housing material	Cast iron	
1.34.8	Enclosure protection	NEMA-4X	
1.34.9	Signal cable length	Minimum 5 meters	
1.34.10	Ambient temperature	0 Deg.C to 80 Deg.C	
1.34.11	Power supply	240 V AC + 10%, 50 Hz.	
1.34.12	Load	Minimum 600 ohms	
1.34.13	Electrical connection	¾" ET.	
1.34.14	Transmitter Output	4-20 mA DC	
1.34.15	Local Indication	LCD display Required.	

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1.34.16	Flange material	ASTM 105	
1.34.17	Accessories	Suitable gaskets, Nut- bolts etc.	
1.35	<u>I/P CONVERTER</u>		
1.35.1	Type	Electro-pneumatic (Outdoor Type)	
1.35.2	Input level	4-20 mA DC	
1.35.3	Output range	0.2 to 1.0 Kg/Sq. cm With 'Fail Freeze' feature. (i.e in case of wire snapping the last good value of pneumatic signal out put will hold for at least six hours)	
1.35.4	Split range	For typical application wherever required.	
1.35.5	Control Action	Selectable air to close, air to open and fail freeze application.	
1.35.6	Supply pressure	1.2 to 1.6 Kg/cm ² (1.4 typical)	
1.35.7	Max. supply pressure	7 Kg/ sq.cm.	
1.35.8	Response Time	5 Seconds for 0 to 90% output pressure.	
1.35.9	Housing	IP 55.	
1.35.10	Repeatability	±0.1% of span.	
1.35.11	Accuracy	± 0.25% of span.	
1.35.12	Supply pressure effect	Less than 1%.	
1.35.13	Span and Zero adjustments	Screw.	
1.35.14	Pneumatic connection	¼" NPT.	

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1.35.15	Stability	Less than 0.25% of Span / Zero for six months.	
1.35.16	Cable connection	¾" ET.	
1.35.17	Mounting	Field (pipe/wall mounting).	
1.35.18	Accessories	Air filter regulator, mounting accessories, cable gland etc.	
1.36	<u>AIR FILTER REGULATOR</u>		
1.36.1	Filter Element	Sintered Bronze.	
1.36.2	Filter Size	5 microns.	
1.36.3	Input Air	10.0 Kg/Sq. cm (maximum)	
1.36.4	Output	Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg/Sq. cm (continuous) as applicable for I/P converter, control drives and control valve.	
1.36.5	Effect of Supply	Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm.	
1.36.6	Bowl Material	Metallic cover around high temperature area/clear transparent polycarbonate with metallic cover for ordinary applications.	
1.36.7	Accessories	2" dial size output pressure gauge.	
1.36.8	Desirable Feature	No perceptible drop of pressure on opening the drain port.	

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1.37	<u>SOLENOID VALVE</u>		
1.37.1	Operating Principle	Electromagnetic. (noiseless)	
1.37.2	Coil voltage rating	240 V AC/220 V DC(as required. Any other voltage, if necessary, to be arranged by Bidder)	
1.37.3	Ways	Generally 3-ways other depending on requirement	
1.37.4	Port size	1/4" NPT all ports.	
1.37.5	Body	SS bar stock.	
1.37.6	Trim	SS-316.	
1.37.7	Duty	Suitable for continuous energization.	
1.37.8	Sealing	Airtight and leak proof.	
1.37.9	Ambient Temperature	0 - 50 °C.	
1.37.10	Fluid Temperature	0-150 °C (approx.)	
1.37.11	Coil Enclosure	Stainless Steel.	
1.37.12	Insulation	Class-H.	
1.37.13	Coil Casing	IP-65 (Explosion proof for NEC Class-1, Division-1 area)	
1.37.14	Mounting	On pipe or on panel.	
1.37.15	Cable Connection	3/4" ET.	
1.37.16	Accessories	Mounting brackets, nuts and bolts.	
1.37.17	Preferred feature	(a) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity.	

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		(b) Local indication for power.	
1.38	<u>SIGHT GLASS</u>		
1.38.1	Type	Flap-type.	
1.38.2	End connection	Screwed / Flanged.	
1.38.3	Material		
(a)	Body	CS/SS as per process medium.	
(b)	Indicator	Stainless steel.	
1.38.4	Sight Glass	Toughened Borosilicate.	
1.38.5	Gasket	Neoprene.	
1.38.6	Bolts & Nuts	High tensile steel.	
1.38.7	Hydraulic Test Pressure	1.5 times maximum working pressure.	
1.38.8	Accessories	As required.	
1.39	<u>LEVEL GAUGE (FLOAT & TAPE)</u>		
1.39.1	Type	Float and Tape	
1.39.2	Float & Tape MOC	AISI 316	
1.39.3	Pulley material	Aluminium	
1.39.4	Guide wire	SS 316 Stainless steel	
1.39.5	Accuracy	± 2 mm	
1.39.6	Indication	On circular or vertical dial	
1.39.7	Rating	Twice the design pressure	

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SR. NO.	ITEM	DESCRIPTION	
1.40	<u>FLOW INDICATING SWITCH</u>		
1.40.1	Type	On line metal tube Rotameter.	
1.40.2	End connection	Flanged.	
1.40.3	Material		
(a)	Body	CS/SS as per process medium.	
(b)	Float	Stainless steel.	
(c)	End fittings/flange	Stainless steel.	
(d)	Other wetted part	Stainless steel.	
(e)	Casing	Di cast Aluminium.	
1.40.4	Accuracy	+/- 2.0% of FSR.	
1.40.5	Rangeability	10:1.	
1.40.6	Electrical connection	¾" ET.	
1.40.7	Switch type	Snap acting hermitically sealed 2 nos. SPDT.	
1.40.8	Contact rating	5A, 240V AC.	
1.40.9	Protection class	IP-65.	
1.40.10	Accessories	As required.	
1.41	<u>ZERO SPEED SWITCH</u>		
1.41.1	Probe		
	(a) Type	Magnetic pick up (inductive type)	
	(b) Size	As per requirement	

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	(c) Protection class	NEMA 4 (IP 65)	
	(d) Enclosure type	Robust cast aluminium	
1.41.2	Electronic unit		
	(a) Supply voltage	240 V AC $\pm$ 10%, 50 Hz.	
	(b) Speed range	As per process requirement	
	(c) Speed setting accuracy	Within $\pm$ 5% of desired value.	
	(d) Repeatability	Within $\pm$ 1%.	
	(e) Differential	Within $\pm$ 5% of set value	
	(f) Output contact type	2 NO + 2 NC	
	(g) Contact rating	240V, 5A AC/ 220V, 0.5A DC.	
	(h) Ambient Temperature	0-60 Deg. C.	
	(i) Preferable features	(i) Red LED for "Supply On"	
		(ii) Green LED for "Relay On"	
		(iii) Display of present speed	
		(iv) Alarm facility with indication	
1.42	<u>BELT SWAY SWITCH</u>		
1.42.1	Type	Microprocessor based	
1.42.2	Body	CI	
1.42.3	Protection class	NEMA 4 (IP 65)	
1.42.4	Enclosure type	Die cast aluminium; Flame proof	
1.42.5	Output contacts	2 NO + 2 NC	

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1.42.6	Contact Rating	240V, 5A AC/ 220V, 0.5A DC.	
1.42.7	Reset facility	Auto reset	
1.42.8	Contact roller support	Bearing with high relative lubrication & low Coefficient of friction.	
1.42.9	Accessories	Canopy	
1.43	<u>PULL CHORD SWITCH</u>		
1.43.1	Type	Microprocessor based	
1.43.2	Body	CI	
1.43.3	Protection class	NEMA 4 (IP 65)	
1.43.4	Enclosure type	Die cast aluminium; Flame proof	
1.43.5	Output contacts	2 NO + 2 NC	
1.43.6	Contact Rating	240V, 5A AC/ 220V, 0.5A DC.	
1.43.7	Reset facility	Manual reset	
1.43.8	Local trip indication	Required	
1.43.9	Operating handle	Fitted with spring steel rings at both ends	
1.43.10	Accessories.	(i) Canopy over lever of pull cord switch.	
		(ii) Linking of switches through a single cable for each section.	
1.44	<u>BELT WEIGHING SYSTEM</u>		
1.44.1	General		
	The mechanical design and constructional features for belt weigher has been described under mechanical section, hence not repeated here. Similarly motor		

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	specifications for the same has been covered under electrical specification, hence not repeated here. (Bidder may also refer ANNEXURE-A, clause no. 5.0 of this section for additional features.)		
	The belt weighing system shall have its own local panel to be located in electrical equipment room. The Local panel shall include: (a) Local flow rate indication (b) Integrated flow indication (c) System alarm annunciation (d) Local calibration facility (e) Power On/ Off All these above displays shall be backlit LCD type with 12mm character height. Battery backup shall be provided for the measurement system. (a) Application : Bulk material, Powder material (b) Drive Protection : Reverse Polarity Communication failure		
1.44.2	Load sensing cell		
	(a) Type	Strain Gauge	
	(b) Enclosure Protection	NEMA 4X (IP 66)	
	(c) Load		
	(i) Nominal load	Bidder to specify in tabular form.	

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	(ii) Rated Load	Bidder to specify in tabular form.	
	(iii) Destructive Load	Bidder to specify in tabular form.	
	(d) Supply Voltage	24VDC	
	(e) Sensing	Resistance bridge.	
	(f) Temp. effect on zero & span	$\pm 0.015\%$ / 10K	
	(g) Basic Resistance	Manufacture's standard	
	(h) No. of load sensors	Single	
	(i) Mounting type	Four idler	
	(j) Accessories	Mounting plate kit, cable etc.	
	(k) Accuracy	$\pm 0.015\%$ FSD	
	(l) Speed sensor	Tacho/ Encoder.	
	(m) Speed output	Pulse train to be distributed to -	
		(i) Local panel for own use	
		(ii) 4-20mA DC signal to PLC	
	(n) Load sensor output	4-20mA DC isolated signal for PLC along with provision for serial communication link standard protocol	
	(o) Computed flow rate		
	(i) Hardware	4-20mA DC isolated 2 numbers	
	(ii) Serial Link	In compliance with standard protocol	
	(p) Protection class for measuring cell	NEMA 4X (IP66)	

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SR. NO.	ITEM	DESCRIPTION	
	(q) Accessories	Special cables, electronics, cabinets etc. as required to make the system complete, with bar/chain.	
	(r) Range	Application dependent.	
	(s) Range increment	0.1% of this selected range.	
	(t) Operating temperature	0 -70 °C	
	(u) Accuracy	± 0.5% FS range	
2.0	<u>CONTROL PANELS/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES</u>		
2.1	<u>COUPLING RELAY</u>		
2.1.1	Type	Octal base plug-in type/ DIN rail Mounting.	
2.1.2	Coil voltage	24 V D.C. in general / other as required.	
2.1.3	Contact	2 NO & 2 NC (Minimum).	
2.1.4	Contact rating	250 V/5A (A.C)/220V/2A (D.C).	
2.1.5	Operating range	70 to 110% of rated voltage.	
2.1.6	Insulation	2 kV for 1 minutes between terminal & earth.	
2.1.7	Mechanical life	20 million operations.	
2.1.8	Coil protection	Diode.	
2.1.9	Indication	Coil on LED.	

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SR. NO.	ITEM	DESCRIPTION	
2.8.10	Preferred Features	Power supply on/failure LED visible from front.	
2.9	<u>PUSH BUTTON</u>		
2.9.1	Type	Shrouded square format.	
2.9.2	Face Dimension	32 x 32 mm (maximum)	
2.9.3	Contact Configuration	2 NO + 2 NC.	
2.9.4	Contact Addition	Add-on block up to 4 each with 2 pairs of contacts.	
2.9.5	Contact Material	Hard Silver Alloy.	
2.9.6	Contact Rating	500V / 10 A.	
2.9.7	Utilization Category	AC11 / DC11.	
2.9.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.	
2.9.9	Mechanical Life	1 million operation.	
2.9.10	Construction	Aluminium shrouding with plastic lens.	
2.9.11	Colours	Red, Green, Yellow, Black, etc.	
2.9.12	Connection	Screw terminals.	
2.9.13	Enclosure Class	IP-52.	
2.9.14	Legend	Engraving.	
2.10	<u>ILLUMINATED PUSH BUTTON</u>		
2.10.1	Type	Square format.	
2.10.2	Face Dimension	32 x 32 mm. (maximum)	

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SR. NO.	ITEM	DESCRIPTION	
2.10.3	Contact Configuration	2 NO + 2 NC. (minimum)	
2.10.4	Contact Addition	Add-on-Block up to 4 each with 2 pairs of contacts.	
2.10.5	Contact Material	Hard Silver Alloy.	
2.10.6	Contact Rating	500 V/ 10A.	
2.10.7	Utilization Category	A C11 / DC11.	
2.10.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.	
2.10.9	Mechanical Life	1 Million Operation.	
2.10.10	Lamp	LED with built-in resistors as required.	
2.10.11	Lamp Rating :		
(a)	Voltage	240 V AC.	
(b)	Watt	2 Watt (approx.)	
2.10.12	Lamp and Lens Replacement	From front.	
2.10.13	Construction	Transparent Plastic Lens.	
2.10.14	Colour	Red, Green, Amber, Yellow etc.	
2.10.15	Connection	Screw terminals.	
2.10.16	Enclosure Class	IP-52.	
2.10.17	Legend	Engraving.	
2.11	<u>SELECTOR SWITCH</u>		
2.11.1	Type	2/3/4 position stay put type with rotary lever actuator.	

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SR. NO.	ITEM	DESCRIPTION	
2.11.2	Face Dimension	32 x 32 mm. (maximum)	
2.11.3	Contact Configuration	4 pair of contacts.	
2.11.4	Contact Addition	Add-on-Block up to 4 each with 2 pairs of contact.	
2.11.5	Contact Material	Hard silver Alloy.	
2.11.6	Contact Rating	500 V/10 A.	
2.11.7	Utilization Category	AC11 / DC11.	
2.11.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.	
2.11.9	Mechanical Life	1 million operation.	
2.11.10	Construction	Aluminium shrouding.	
2.11.11	Connection	Screw terminals.	
2.11.12	Enclosure Class	IP-52.	
2.12	<u>INDICATING LAMP</u>		
2.12.1	Type	LED with built-in resistor.	
2.12.2	Face Dimension	32 x 32 mm. (maximum)	
2.12.3	Voltage	240 V AC.	
2.12.4	Watt	2.5 Watt (approximate).	
2.12.5	Lamp and Lens Replacement	From front.	
2.12.6	Construction	Transparent Plastic lens.	
2.12.7	Colour	Red, Green, Amber, Yellow etc.	
2.12.8	Connection	Screw terminals.	

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SR. NO.	ITEM	DESCRIPTION	
2.12.9	Legend	Engraving.	
2.13	<u>INDICATING METERS (A.C)</u>		
2.13.1	Type	Rectifier type.	
2.13.2	Face Dimension	96 x 96 mm.	
2.13.3	Scale	Radial arc of 240 Deg.	
2.13.4	Accuracy	1.5% of full scale. ± 0.5 Hz for frequency meter.	
2.13.5	Input	0-1/0-5A for current measurement, 0-240V, 50 $\pm$ 2.5 Hz for voltage/ frequency measurement.	
2.13.6	Zero Adjustment	Screw on meter face.	
2.13.7	Enclosure	Shielded Case.	
2.13.8	Mounting	Flush Panel.	
2.13.9	End Scale Suppression	6 times the measuring range only for motor ammeters.	
2.14	<u>INDICATING METERS (D.C)</u>		
2.14.1	Type	Taut band moving coil.	
2.14.2	Face Dimension	96 x 96 mm.	
2.14.3	Scale	Radial arc of 240 Deg.	
2.14.4	Accuracy	1.5% of full scale.	
2.14.5	Input	0-75 mA for current measurement. Direct reading for voltage measurement.	

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5.1 <u>CONDUCTIVITY ANALYZER</u> 5.1.1 Sensor (a) Type of Cell : Flow thru'. (b) Conductivity Range : As per instrument schedule (c) Cell Constant : 0.01/0.1/1.0 depending upon range. (d) Temp. Compensation : Manual and Automatic (Integral) 0-100°C. (e) Process Connection : Screwed. (f) Wetted Parts : Electrodes-SS316L/ Insulators KYNAR/Viton. (g) Pressure Rating : 10 kg/cm². (h) Accessories : Vessel (SS 316) with ½" NPT connection. (i) Cable : Upto transmitter in flexible conduct. 5.1.2 Transmitter (a) Type : Microprocessor based, Single stream (b) Mounting : Flush Panel. (c) Protection Class : IP-55 or better. (d) Output : 4-20 mA DC (isolated). (e) Display : Digital Display in Engineering Unit, Alarm Status. (f) Zero/Span Adjustment : Front Panel Membrane type		

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Keyboard. (g) Temp. Compensation : Manual or Automatic. (h) Diagnostic : Self diagnostic for electronics, electrode etc. (i) Alarm : Dual set point, hysteresis and time delay adjustable. (j) Enclosure : Die cast aluminium, epoxy coated. (k) Cable Termination : Internal (cable entry through conduit). (l) Accuracy : ± 1.0 % of measured range. (m) Response time : Less than 5 sec. (n) Stability : ± 1.0 % of output range / month non-cumulative. (o) Accessories : For cation conductivity- Dual Ion-Exchange column, resin, etc. (minimum 12 months' requirements). 5.2 <u>pH ANALYZER</u> : 5.2.1 Sensor : (a) Type of Cell : Flow thru'. (b) Range : 0-14 pH. (c) Type of measurement : Combination electrode. (d) Temp. Compensation : Manual and Automatic (Integral) 0-100 °C.		

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(e) Process Connection : Screwed. (f) Measuring Electrode : Glass. (g) Pressure Rating : 10 kg/cm². (h) Accessories : Vessel (SS 316) with ½" NPT connection. (i) Cable : Upto transmitter in flexible conduct. (j) Preamplifier : Integral or separate. (k) Liquid Junction : Ceramic / Kyner or equivalent. 5.2.2 Transmitter : (a) Type : Microprocessor based, Single stream (b) Mounting : Flush Panel. (c) Protection Class : IP-55 or better. (d) Output : 4-20 mA DC (isolated). (e) Display : Digital Display in Engineering Unit, Alarm Status. (f) Repeatability : ± 1% or better. (g) Temp. Compensation : Manual or Automatic. (h) Diagnostic : Self diagnostic for "Calibration required"/ "Calibration O.K.", electrode checking etc. (i) Alarm : Dual set point, hysteresis and time delay adjustable.		

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(j) Enclosure : Die cast aluminium, epoxy coated. (k) Cable Termination : Internal (cable entry through conduit). (l) Accuracy : $\pm 0.2\%$ of FSD or better. (m) Response time : Less than 5 sec. (n) Stability : ± 0.001 pH /week. (o) Accessories : Ultrasonic Electrode Cleaner, Buffer solution tablets. 5.3 <u>SILICA ANALYZER</u> : (a) Type : Colorimetric monitor, gravity / pumped feed Microprocessor based. (b) Output : 4-20 mA DC (isolated) into 600 ohms. (c) Readout : Digital Indicating meter for direct readout. (d) Accuracy : $\pm 1\%$ of F.S.D or better. (e) Reproducibility : $\pm 2\%$ of F.S.D. or better. (f) Calibration : Manual & automatic. (g) Cycle time : Less than 10 min or better. (h) Operating temperature : 0-45 °C . (i) Mounting : Flush panel. (j) Life of light source : 9,000 hours (approx.).		

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(k) Alarm Facility : 2 HI & 2 LO independently adj. over span. (l) Alarm for : Monitor mal-function. : Monitor on standby. : Monitor auto-zeroing. : Concentration high. : Loss of sample. : Concentration low. : Loss of reagent. (m) Accessories : Reagent cabinet. : Sample strainer. : Reagent Reservoir etc. : Phenolic name plate. : Reagents & consumables for 1 year. : Special cables. 5.4 <u>SODIUM ANALYZER ASSEMBLY</u> : (a) Type of Cell : Flow Through ion-selection electrode. (b) Flow Chamber : Plexi Glass Body or equivalent. (c) Measuring Electrode : Sodium Selective Glass Electrode. (d) Output : 4-20 mA DC (isolated) into 600		

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ohms. (e) Temp. Compensation : Automatic upto 45 Deg.C. (f) Read Out : Digital Indicating meter. (g) Accuracy : < 5% of reading. (h) Response Time : 2 minutes or better. (i) Mounting : Flush Panel. (j) Calibration : Automatic. (k) Alarm Facility : 2 HI and 2 LO independently adj. over span. (l) Accessories (Preassembled, pre-wired and pre-tubed in enclosure) : Phenolic tag plate etc. : Sample filter. : Pressure regulator & flow meter. : Automatic calibration kit. : Reagents and consumables. : Special cables. 5.5 <u>HYDRAZINE ANALYZER</u> : (a) Type : Electrochemical Type. (b) Output : 4-20 mA DC linear. (c) Readout : Digital Indicating Meter, linear read-out. (d) Accuracy : $\pm 2\%$ of FSD or better. (e) Reproducibility : 2% of FSD or better.		

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(f) Drift : 2 ppb/month or better. (g) Temp. Compensation : Automatic up to 45 °C. (h) Response Time : 1 minutes or better. (i) Mounting : Flush Panel. (j) Alarm Facility : 2 HI and 2 LO independently adj. over span. (k) Preferred Feature : 2 Hi and LO alarm LED visible from front. : Power supply on/failure LED. (l) Accessories : Chemical reagents for 12 months.		
5.6	<u>DISSOLVED OXYGEN ANALYZER</u>	:
(a) Type : Electro-chemical, Microprocessor based. (b) Range : As per approved instrument schedule (c) Type of Cell : Flow through sampling type (continuous). (d) Enclosure : IP-55 or better. (e) Output : 4-20 mA DC isolated to a load of 600 Ohms (minimum). (f) Temp. Compensation : Automatic up to 45 Deg.C (g) Readout : Digital Indicating meter. (h) Accuracy : Better than $\pm 4\%$ of full scale for Transmitter.		

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(i) Sensor Response Time : 90% in 30 seconds or better. (j) Mounting : Flush panel. (k) Alarm Facility : 2 HI & 2 LO independently adj. over span. (l) Preferred Feature : HI & LO Alarm LED visible from front. : Power supply on/failure LED. : In-built calibration facility. (m) Accessories : Reagent Cabinet (if applicable). : Reagent Reservoir (if applicable). 5.7 <u>CHLORIDE ANALYZER</u> : (a) Type : Electro-chemical, Microprocessor based. (b) Type of Cell : Chloride Ion Selective Electrode. (c) Enclosure : IP-55 or better. (d) Output : 4-20 mA DC isolated to a load of 600 Ohms. (e) Temp.Compensation : Automatic with Pt 100. (f) Ambient Temp. : 45 Deg. C (g) Readout : Digital Indicating meter. (h) Accuracy : $\pm 2\%$ or better. (i) Reproducibility : $<3\%$. (j) Detection Limit : 0.5 mg/l or better.		

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(k) Analysis Time : 5 minutes (max). (l) Cycle time : Adjustable. (m) Calibration : Manual and automatic. (n) Mounting : Flush panel. (o) Alarms : 1 HI, 1 LO and 1 system alarm. (p) Control accessories : Sample level detector. : Reagent level detector. : Calibration solution level detector. : Automatic sample, rinse and drain valve. : Pump for reagent solution. : Pump for calibration solution. (q) Accessories : Reagent solution tank. : Calibration solution tank.		
5.8	<u>SAMPLE CONDITIONING SYSTEM</u>	
5.8.1	Sample conditioning system shall be designed and constructed to receive and condition all samples as required by the respective analyzers. This shall include all conditioning equipment mentioned herein:	
	(a) Sample filtering. (b) Primary and final sample cooling and temperature control. (c) Pressure reduction and control, as required. (d) Flow rate control.	

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4.0 <u>CONTROL DESK / PANELS / RACKS</u>		
(a) Convenient and logical approach to operational interfaces and aesthetics in the overall view of the panel /desk shall be considered. (b) For items susceptible to vibration, suitable anti-vibration padding shall be provided to prevent damage or malfunction. (c) All items inside the panels/cabinets shall be neatly arranged with easy access/maintenance approach. (d) Incoming power supply feeders shall be duplicated . Alarm shall be provided for failure of a power supply feed. (e) Desk/panel shall be provided with interior illumination, utility receptacles with plug and cooling fan. (f) Panel/Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm. (g) Wire shall be routed /laid through covered trough. (h) 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. (i) Nameplate (i) Nameplate shall be provided for instrument or device mounted on the panel. (ii) Nameplates for panels shall be provided both in front and rear. (j) All local control panels shall be housed in air condition environment.		

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4.1 <u>CONTROL DESK</u> 4.1.1 Devices mounted on the desk shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others. 4.1.2 Desk shall be ergonomically designed to suit working on a 24 X 7 basis. Aesthetics, ergonomics and illumination shall be considered while positioning of the desk, large video screen and panels in control room. 4.1.3 Control desk shall be free standing floor mounting type of table-top design with compartments for locating the hardware. Desk shall be constructed from aluminum extrusion with high pressure laminate MDF board for work surface of approved colour. Aluminium structure shall be anodized or powder coated paint finish. Thickness of sheet shall not be less than 3 mm. 4.1.4 Monitors with retractable keyboard, emergency push buttons 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. 4.1.5 Desk shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections. 4.1.6 Desk shall have concealed cable trays for wire dressing. 4.1.7 Design shall include Earthing bolts. 4.1.8 Back installed items shall be suitably concealed from front view. 4.2 <u>BACK UP PANEL</u> 4.2.1 Construction shall be from sheet steel of thickness not less than 3 mm. 4.2.2 Electrical upright Panel construction & design shall be similar to back up panel. Control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. along with associated mimic diagram, as recommended, shall be provided for manual synchronization of generator.		

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4.2.3	Cabinets/Enclosure/Panels		
(a)	Material of construction	:	Cold rolled steel sheet.
(b)	Thickness of Sheet	:	(i) 2.0 mm for faces supporting instruments / terminals.
(c)	Construction	:	Welded throughout as per approved National Standards.
(d)	Panel height	:	2300 mm. (approx)
(e)	(i) Corners	:	7 mm inner radius.
	(ii) Dimensional	:	a. In height & length - 3 mm.
	(iii) Tolerances	:	b. In height between adjacent sections - 2 mm.
		:	c. Total for a group - 6 mm.
(f)	Doors	:	Double, recessed, turned back edges.
	(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.
(g)	Color of interior	:	Brilliant white.
(h)	Colour external	:	RAL 7032.

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(i)	Painting	:	Epoxy powder coated or better.
(j)	Gland plates	:	Removable 3 mm thick. (bottom)
(k)	Cable entry	:	Bottom.
(l)	Hardware	:	(i) Anti vibration pad- 15 mm. (ii) Predrilled base channel ISMC - 10 or equivalent for all sides. (iii) Stainless steel buff- finished 2 mm thick kick plate for all sides. (iv) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws. (v) Rubber strips to ensure air tightness between kick plate and finished floor. (vi) Lifting hook / Eye bolt. (vii) Drawing pocket. (viii) Door switch, lamps, thermostat, heaters and fans.
(m)	Enclosure Protection	:	As per environment condition of the area of installation. Refer section-1 of this vol.
4.3	<u>LOCAL INSTRUMENT RACKS & ENCLOSURE</u>		
4.3.1	General Requirements		
(a)	Devices located in the field shall be grouped and installed in the enclosure (Closed Rack) in outdoor areas such as Boiler area etc. and in Open Type Rack in covered areas such as TG Building.		

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(b) 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., (c) No more than six instruments shall be grouped in a single rack/ enclosure. (d) 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. (e) Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air/gas piping. (f) Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping. (g) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure except for low pressure and vacuum measurement for which the test pressure will be as per piping standard. (h) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential pressure measurement such as flue gas and coal air mixture application. Pressure measurement shall have only intermittent purging whenever required. In case of continuous purging, an air header shall be formed which shall receive service air through isolation valve and air filter regulator. Air shall be fed from the air header to both the impulse pipes near to take off points through isolation valves and flow regulators. Air header shall be constructed from stainless steel. Impulse pipe for such applications shall have a four-way valve. One port of the valve shall have an adaptor to connect flexible stainless steel braided nylon hose to the service air. Rating of the hose shall not be less than 10 Kg/sq.cm. Four way valve shall have two position operations. One position for service and other one for purging. Required pressure gauges shall be provided for monitoring of air pressure. Complete purging arrangement shall be integral to the enclosure and racks.		

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(i) Gate or ball type (full ported) instrument isolation valve and globe type blow down drain valve adequate for duty requirement and for withstanding continuous design pressure and temperature of main process medium shall be provided in the hook up plumbing. For process pressure equal or above 40 kg/ sq.cm single instrument isolation valve and double blowdown valves shall be used before connecting to blowdown header. Whereas for line pressure less than 40 kg/sq.cm, single instrument isolation valve and single blow down valves can be used before connecting to blow down header. Instrument manifolds shall be non integral and shall be installed close to the instrument. (j) Drawing No. PE-189-IN-SK-8004/P0 (Sheets 10) shall be referred for typical arrangement of Local instrument enclosure and rack. 4.3.2 Closed Instrument Rack (a) 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. (b) 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 color finish. (c) 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. (d) 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. (e) 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.		

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(f) 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. (g) All internal wirings between the instruments and junction box shall run through flexible conduits. (h) 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. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header. (i) Each rack shall be provided with one receptacle, light fixtures each at instrument & Junction box compartments with wire guard. 4.3.3 Open Instrument Rack (a) 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. Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable protective grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project. Canopy shall be of CRCA steel sheet of at least 3 mm thickness. Center posts or any member, which would reduce access, shall be avoided. (b) 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments. (c) All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible. (d) All 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. Header		

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shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header. 4.3.4 Junction Box Junction boxes of metallic construction. (a) Junction box shall be provided at a dry compartment at one side of the enclosure/rack with front opening type door. Junction box shall be of sheet steel construction with thickness not less than 2 mm. Earth stud shall be furnished at rack for safety grounding. (b) Terminals shall be screwless cageclamp type of reputed make and 20% spare terminals shall be furnished in the junction box. 5.0 <u>DISTRIBUTED CONTROL SYSTEM (DCS)</u> 5.1 <u>SYSTEM FUNCTIONAL DESCRIPTION</u> 5.1.1 Integrated functionally & geographically distributed and hierarchically structured real time control (both binary and modulating), Data acquisition, Man machine interface, Historization units and Management Information System (MIS) system synthesized from one general family of identical interchangeable multifunction hardware has been envisaged. 5.1.2 System shall be highly reliable with the availability of not less than 99.7% with adequate redundancy and fault tolerant configuration. 5.1.3 The system shall be unitized and connectivity with other plant control system & Plant wide network has been envisaged. 5.1.4 Remote input output stations as a data concentrator for acquisition and monitoring of non critical parameters like Boiler metal temperature and Generator winding temperature etc, are foreseen. RIO shall be industrially ruggedized and shall be provided with integral air conditioner considering the harsh environment. 5.1.5 For Power supply to DCS system refer Volume V , Section-10.		

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		CORRIGENDUM - II	
Sr. No.	Specification	Description	
1.0	<u>FEATURES</u>		
1.1	Type	FRP Junction box	
1.2	Mounting	4 corner embedded nut for mounting (as per drg.)	
1.3	Cable entry	From bottom	
1.4	Cable gland holes	Holes will be provided at the bottom of JB for fixing cable glands.	
1.5	No. Of terminals	12,24,36,48,64,72,96,128,256,512,1024 (inclusive of spare 20%)	
1.6	Terminal	Numerical ferrules	
1.7	Door	Door hinged type, additional screws will be provided if required to achieve IP65 protection. Lock with handle & universal key.	
1.8	Terminal type	Cage clamp(280-101) 'DIN' rail mounted	
1.9	Earthing stud	M6x30mm long (brass)	
1.10	Mounting stud	M8x20mm (MS) Nickel plated.	
1.11	Degree of protection	As per clause C7.6 of IS 13947.	
2.0	<u>MATERIAL</u>		
2.1	Case/door	4mm+1mm THK. FRP. Sheet.	
2.2	Coating	Pigmented colour as per project requirement from inside out of the J.B	
2.3	Gasket	Neoprene type gasket with corner joints.	
2.4	Metal tag	Aluminium plate 1 mm THK. (Anodised) letter size 6mm height. Black background & white letter (engraved)	
2.5	Nut & bolts	Removable bolts (MS), will be provided.	

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		CORRIGENDUM - II		
Sr. No.	Specification	Description		
3.0	<u>TESTS</u>			
3.1	Routine & acceptance test	Visual, G.A., layout Dimensions, coating thickness (on metallic piece) component rating IR & HV. Test.		
3.2	Type test	Degree of protection test is-13947 (part no-1)-1993 certificate to be submitted.		

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10.0	<u>CONTROL & INSTRUMENTATION CABLE</u>	
10.1	Cables shall be flame retardant low smoke (FRLS) type. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety.	
10.2	Durable marking shall be provided on the surface of the cable at intervals not exceeding 5 mtrs. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs/ triads/type of compensating /extension cable), Insulation material, FRLS etc. Sequential length marking shall also be provided at every meter interval on outer sheath of cable.	
10.3	Standard seasoned wooden drum containing minimum 500 /1000 M $\pm$ 5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.	
10.4	<u>THERMOCOUPLE EXTENSION & COMPENSATING CABLE</u>	
	(a) Conductor	: Solid conductor.
	(b) Conductor size	: 16 AWG (1.31 Sq. mm)
	(c) Type	: KX (Extension) (Chromel Alumel) RX (Compensating) (Copper-Copper alloy) JX (Extension) (Iron Constantan).
	(d) Conductor Insulation	: HR PVC Type-C (IS-5831,1984) 0.6 mm thick.
	(e) Operating Voltage	: 300V /500V RMS (Core to earth / core to core).
	(f) Twisting	: Pair twisted with lay of 60 mm (max)
	(g) Twisting Direction	: All pairs in the same direction. Lapped to form bunch with mylar tape.

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(h)	Screen (Pair & Overall)	:	Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.
(i)	Drain wire	:	Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands/size:- 7/0.3mm)
(j)	Inner Sheath	:	Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554Part-I 1976.
(k)	Rip Cord	:	Non metallic under sheath.
(l)	Armouring	:	GI wire/strip as per IS 3975.
(m)	Outer Sheath	:	Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554Part-I 1976.
(n)	Filler	:	Non hygroscopic with FRLS property.
(o)	Temperature Range	:	Up to 85 $^{\circ}\text{C}$.
(p)	Insulation at 20 $^{\circ}$ C	:	100 MOhms/Km [Min].
(q)	Capacitance at 800 Hz	:	120 nf/km.

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(r) Cross talk : 60 dB. (s) Attenuation : 1.2 dB/Km (t) Codes & Standards : IEC 332-1. ANSI MC 96.1. IS-8784-1987. (u) Tests (i) Oxygen Index: Min.29 at room temp. (ASTM-D-2863) (ii) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I (iii) Temp Index : Min 250 DEG C at 21 Oxy. Ind. (ASTM-D-2863) (iv) Smoke Density Rating : Max.60% (ASTM-D-2843). (v) Flammability Test : as per IEC 332 Part-I/IEEE-383 Swedish Chimney Test - SS-424-1475 F3. (vi) High voltage test Core to core- 1.5 kV for 1 min. Core to screen-1.0 kV for 1 min. (vii) Insulation Resistance 100 M Ohm/Km Min. (viii) Rodent & Termite repulsion test (Presence of lead shall be confirmed)		

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(v)

Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1.

CABLE TYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
KX	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
JX	Black	Positive	White	Iron
		Negative	Red	Constantan
RX	Green	Positive	Black	Copper
		Negative	Red	Copper Nickel Alloy

(w)

Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs.

10.5

INSTRUMENTATION MULTI PAIRED SIGNAL CABLE

(a)

Conductor type

:

Stranded (7) annealed tinned copper.

(b)

Conductor size

:

0.5/1.0/1.5 Sq.mm. (as required)

(c)

Conductor resistance

:

39 Ω/Km/18 Ω/Km/12 Ω/Km.

(d)

Conductor Insulation

:

HR PVC Type-C (IS-5831,1984) 0.6 mm thick.

(e)

Operating Voltage

:

300/500V RMS. (Core to earth/core to core)

(f)

Twisting

:

Twin twisted with lay of 60 mm.

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(g) Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape. (h) Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. (i) Analog signals- Individual pair & overall shield to be considered. (ii) Binary signals- overall shield to be considered. (i) Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm) (j) Inner Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554, Part-I 1976 (k) Rip Cord : Non metallic under sheath. (l) Armouring : GI wire/strip as per IS 3975 (m) Outer Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties).			

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HR PVC Type ST2 of IS-5831,1984. Thickness as per IS-1554, Part-I 1976. (n) Filler : Non hygroscopic with FRLS property. (o) Temperature Range : 85 °C. (p) Insulation at 20 : 100 MOhms/Km [Min] Deg.C (q) Capacitance at 800 : 120 nf/km Hz (r) Cross talk : 60 dB. (s) Attenuation : 1.2 dB/Km. (t) Codes & Standards : (i) IPCEA-S-61-402. (ii) BS 5308. (iii) IEC 332-1. (iv) ASTM-B-33. (v) IS-8130-1984. (vi) IS 1554 Part-1. (vii) IS 10810. (u) Sheath color : Inner- Black and Outer- Gray. (v) Tests (i) Oxygen Index: Min.29 at room temp. (ASTM-D-2863). (ii) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I. (iii) Temp Index: Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863).			

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(iv) Smoke Density Rating: Max.60% (ASTM-D-2843). (v) Flammability Test : as per IEC 332 Part-I. (vi) Swedish Chimney Test-SS-424-1475 F3. (vii) Insulation Resistance 100 M Ohm / Km Min. (viii) High voltage test Core to core- 1.5 kV for 1 min. Core to screen- 1.0 kV for 1 min. (ix) Rodent & Termite repulsion test (Presence of lead shall be confirmed). (w) Colour of core for Instrumentation Cable (As per IS-9938) <table border="1"> <thead> <tr> <th>PAIR</th><th>CORE</th><th>COLOR</th></tr> </thead> <tbody> <tr> <td>1st</td><td>1st</td><td>Blue</td></tr> <tr> <td>1st</td><td>2nd</td><td>Red</td></tr> <tr> <td>2nd</td><td>1st</td><td>Gray</td></tr> <tr> <td>2nd</td><td>2nd</td><td>Yellow</td></tr> <tr> <td>3rd</td><td>1st</td><td>Green</td></tr> <tr> <td>3rd</td><td>2nd</td><td>Brown</td></tr> <tr> <td>4th</td><td>1st</td><td>White</td></tr> <tr> <td>4th</td><td>2nd</td><td>Black</td></tr> </tbody> </table>			PAIR	CORE	COLOR	1 st	1 st	Blue	1 st	2 nd	Red	2 nd	1 st	Gray	2 nd	2 nd	Yellow	3 rd	1 st	Green	3 rd	2 nd	Brown	4 th	1 st	White	4 th	2 nd	Black
PAIR	CORE	COLOR																											
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	Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.	
10.6	Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTM D 2116. These cables shall be pair, multipair, triad, multitriad and twisted & shielded.	
10.7	<u>CONTROL & POWER CABLE</u> Bidder shall refer to Volume IVB of the electrical specification for detail.	
11.0	<u>ERECTION HARDWARE</u> This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.	
11.1	<u>ELECTRICAL ACCESSORIES</u> Electrical conduit and associated materials shall conform to the requirements of the articles which follow: (a) Rigid Steel Conduit (i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm. (ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.	

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(iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends. (iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply. (b) Flexible Conduit (i) Flexible conduit shall be of three-layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material. (ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/ Sq. cm and temperature up to 200 °C. (c) Special Fittings (i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed. (ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.		

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11.1.1 Electrical Junction Box (a) Type of Enclosure : Dust tight & weatherproof conforming to IP 65. (b) Material : 3 mm sheet steel (c) Type of Cover : Solid unhinged with retention chain. (d) Paint : External - RAL 7032, Internal – Brilliant White. (e) Mounting : Surface (f) Cable Entry : 3 mm (min) Gland plate (g) Gasket : Neoprene (h) Grounding : Brass earth lug with green screw head External-2 nos , Internal-1no.M6. (i) Number of Drain Holes : Two at bottom capped. (j) Identification : Label for JB and Tags for cable. (k) Accessories : (i) Rail mounted cage clamp type screwless terminals with markers. : (ii) Cable gland : (iii) Ferrules : (iv) Canopy at top 11.1.2 Cable Gland (a) Type : Double compression (b) Entry Thread : NPT		

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(c) Material : Brass (d) Finish : Cadmium Plated (e) Protection : IP 54 or better (f) Accessories : Neoprene gasket, locknuts, reducers etc. 11.1.3 Cable Tray (a) Material : Mild steel, slotted (b) Thickness : not less than 2.0 mm (c) Finish : Hot dip galvanized (d) Perforation : As per MFR standard (e) Cover : Suitable for tray 11.2 <u>PROCESS HOOK UP ACCESSORIES & SPECIFICATION</u> Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval. 11.2.1 Seamless Stainless Steel Pipe (a) Reference : ASTM A-312 TP 316 (b) Material Grade : TP 316 (c) Type : Seamless /Plain end (d) Size : ½" NB (e) Schedule : 40 (f) Standard Length : 5 meter		

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11.2.2 Stainless Steel Pipe Fittings (a) Reference : ASTM A-182 F 316 / ANSI B16.11 (b) Type : Forged (c) Rating : 3000 lbs / 6000 lbs / 9000 lbs (d) Size : ½" NB (e) End connection : Generally socket weld (f) Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. 11.2.3 Seamless Stainless Steel Tube (a) Reference : ASTM A-213 TP 316 (b) Material Grade : TP 316 (c) Size : ½" OD X 2.1 MM Thick (d) Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube. (e) Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80. (f) Test Pressure : 400 Kg/Sq. cm (minimum) (g) Tolerance : ± 0.13 mm for outside diameter		

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± 15 % for wall thickness. (h) Standard Length : 5 meter (i) Test : Flare, Hardness, Ball and Bubble Test. 11.2.4 Stainless Steel Tube Fittings (a) Reference : ASTM-A-182 (b) Type : Double ferrule double compression. (c) Material : 316 Stainless steel forged. (d) Ferrule : 316 Stainless Steel. (e) Type of Fittings : Male/female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation. (f) Size : To suit SS tubing and NPT end connection. 11.2.5 C.S. Pipe (a) C.S. Pipe : ASTM-A 106 Gr. C (b) Material : Cold drawn seamless black C.S (c) Type : Seamless/Plain ends. (d) Size : ½" NB (e) Schedule : 80, 160, XXS as required. (f) Standard Length : 6 meter		

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11.2.6 C.S. Pipe Fittings (a) Reference : ASTM-A 105/ANSI B16.11 (b) Type : Forged (c) Rating : 3000 lbs/6000 lbs/9000 lbs (d) Size : ½" NB (e) End connection : Generally socket weld. (f) Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. 11.2.7 A.S. Pipe (a) Reference : ASTM-A 335 P22 AS PER ANSI B 36.10 (b) Material : Cold drawn seamless A.S (c) Type : Seamless / Plain ends (d) Size : ½" NB (e) Schedule : XXS (f) Standard Length : 5 meter 11.2.8 A.S. Pipe Fittings (a) Reference : ASTM-A 182 F22 AS PER ANSI B 16.11 (b) Type : Forged (c) Rating : 9000 lbs (d) Size : ½" NB		

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(e) End connection : Generally socket weld (f) Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. 11.2.9 Carbon Steel Globe Valve (a) Reference : ASTM A-105 (b) Type : Globe (c) Construction : Forged Body Cadmium Plated. (d) End Connection : ½" Socket Weld (e) Rating : Cl. 800 / CL. 2500 (f) Material : Body - Carbon steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited (g) Packing : Teflon / Grafoil as required (h) Yoke : ASTM A105 (i) Handwheel : Carbon steel (j) Design standard : As per ANSI B 16.34 11.2.10 Stainless Steel Globe Valve (a) Reference : ASTM A-182 F316 (b) Type : Globe (c) Construction : Forged Body (d) End Connection : Socket Weld (e) Proof Pressure : 400 Kg/Cm2 (f) Material : Body - Stainless steel		

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Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited (g) Packing : Teflon as required (h) Yoke : ASTM A182 F316 (i) Handwheel : Carbon steel (j) Design standard : As per ANSI B 16.34 11.2.11 Alloy Steel Globe Valve (a) Reference : ASTM A-182 F22 (b) Type : Globe (c) Construction : Forged Body (d) End Connection : ½" Socket Weld (e) Rating : CL. 2500 (f) Material : Body - Alloy steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited (g) Packing : Grafoil as required (h) Yoke : ASTM A182 F22 (i) Handwheel : Carbon steel (j) Design standard : As per ANSI B 16.34 11.2.12 Condensate Pot (a) Reference : ASTM A182 F22 / ASTM A105 (b) Material : Alloy steel/carbon steel as per applicatio		

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(c) Construction : Drilled from bar stock (d) End connection : 3 nos. ½" socket weld end (e) Accessories : Vent valves 11.2.13 Instrument Valve Manifold (f) Type : (i) Two valve manifold : (ii) Five valve manifold (g) Mounting : Remote 2" Pipe Mounting (h) Construction : Single block (bar stock) (i) Material : Forged body and bonnet AISI 316 stainless steel. (j) Ports : 1/2 " NPT (F) (k) Rating : 420 Kg/Sq. cm at ambient (l) Operating Temperature : (-) 30 to (+) 170 Deg C (m) Packing : PTFE Wafer (n) Seat & Stem : AISI 316 SS (o) Plug : AISI 316 SS free to turn on stem/17-4 PH. (p) Handle Bar : AISI 316 SS (q) Connection : Straight (r) Accessories : (i) Plugs for all ports. : (ii) Mounting Bracket , bolts , nuts.		

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11.3	<u>PNEUMATIC HOOK UP ACCESSORIES</u>		
11.3.1	Air Header	:	
	(a) Technical Particulars	:	For Panel For Field
	(b) Material of Construction	:	Stainless steel Stainless steel
	(c) Inlet Connection	:	2" NPT (M) 1" NPT (M)
	(d) Header Take-off	:	Stainless steel Stainless steel
	(e) Take off connection	:	1 / 2" NPT (M) 1 / 2" NPT (M)
	(f) Tube Take-off	:	Tube adapter on valve Tube adapter on valve
	(g) Drain	:	SS drain valve at lowest point SS drain valves at lowest point
11.3.2	Seamless Stainless Steel Tube		
	(a) Reference	ASTM A-269 TP 316	
	(b) Material Grade	TP 316	
	(c) Size	¼" OD X 0.049" wall thickness.	
	(d) Type	Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.	
	(e) Properties	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.	
	(f) Test Pressure	400 Kg/Sq. cm	

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(g) Tolerance ± 0.13 mm for outside diameter ± 15 % for wall thickness (h) Standard Length 5 meter (i) Test Flare, Hardness, Ball and Bubble Test		
12.0	<u>SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR DCS/PLC AND OTHER SYSTEMS</u>	
12.1	Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.	
12.2	The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.	
12.3	Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.	

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	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION: C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR LOCAL CONTROL PANEL		

7.10 PANELS, CUBICLES AND ENCLOSURES

7.10.1 General

- (a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.

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Unless otherwise specified cable entry for panels/desks/cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust. (b) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection. (c) Panel/cabinet shall have eyebolt on top for lifting. 7.10.2 Surface Preparation and Painting Sheet metal exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below: (a) 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. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting. (b) Two spray coats of epoxy primer surface shall be applied to all exterior and interior surfaces, each coat of primer surface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish colour (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colours for exterior and interior surfaces shall conform to the following shades: (i) Exterior – RAL 7032. (ii) Interior - Brilliant White.		

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(c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable. 7.10.3 Wiring Wiring within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following: (a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. (b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross-identification. (c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used. (d) Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. (e) 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. (f) All low-level signal cables shall be separately bundled from control cable. (g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall 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. (h) Shield wires shall be terminated on separately.		

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(i) Common connections shall be limited to two wires per terminal. (j) 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 to the conductor. (k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. 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. (l) Panel internal wiring shall follow distinct colour-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc. (m) Panels/cabinets /desks shall be provided with removable gasketed cable gland plates and cable glands. Split type grommets shall be used for prefab cables. (n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981. (o) Wire sizes used for internal wiring shall not be lower than the followings: <table border="0" style="margin-left: 40px;"> <tr> <td style="padding-right: 20px;">(i) Control wiring (switches, pushbuttons etc.)</td> <td style="padding-right: 20px;">:</td> <td>1.5 Sq.mm</td> </tr> <tr> <td style="padding-right: 20px;">(ii) Power supply/receptacle /illumination wiring</td> <td style="padding-right: 20px;">:</td> <td>2.5 sq. mm or higher as per load/</td> </tr> <tr> <td style="padding-right: 20px;">(iii) 4-20mA DC current and low voltage signal upto 24V DC</td> <td style="padding-right: 20px;">:</td> <td>0.5 Sq. mm</td> </tr> </table>			(i) Control wiring (switches, pushbuttons etc.)	:	1.5 Sq.mm	(ii) Power supply/receptacle /illumination wiring	:	2.5 sq. mm or higher as per load/	(iii) 4-20mA DC current and low voltage signal upto 24V DC	:	0.5 Sq. mm
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(ii) Power supply/receptacle /illumination wiring	:	2.5 sq. mm or higher as per load/									
(iii) 4-20mA DC current and low voltage signal upto 24V DC	:	0.5 Sq. mm									

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(p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists. 7.10.4 Grounding (a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system. (b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 6 mm cross section, extending along the entire length of the panel/desk/cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure. (c) The panel/desk/enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug. (d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus. (e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.		

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(f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure. 7.10.5 Panel/Cabinet/ Desk/Enclosures Environmental Protections (a) Panels, cabinets, desks, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table: <table border="1" data-bbox="432 797 1410 1619"> <thead> <tr> <th>SR. NO.</th><th>LOCATION</th><th>ENCLOSURE TYPE</th></tr> </thead> <tbody> <tr> <td>(i)</td><td>Indoor type non- ventilated enclosure in non-hazardous area</td><td>IP-54.</td></tr> <tr> <td>(ii)</td><td>Indoor type ventilated enclosure in non-hazardous area</td><td>IP -42.</td></tr> <tr> <td>(iii)</td><td>Enclosure in Air conditioned area</td><td>IP-22 with suitable canopy at top to prevent ingress of dripping water.</td></tr> <tr> <td>(iv)</td><td>Outdoor type in non-hazardous areas</td><td>IP-55.</td></tr> <tr> <td>(v)</td><td>Outdoor in hazardous areas</td><td>As per requirements of the NEC Code for the location.</td></tr> </tbody> </table> 7.10.6 Terminal Blocks (a) Terminals shall be chromated galvanized DIN rail mounted screw less cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm². Terminal blocks shall conform to IEC 947-7-1.			SR. NO.	LOCATION	ENCLOSURE TYPE	(i)	Indoor type non- ventilated enclosure in non-hazardous area	IP-54.	(ii)	Indoor type ventilated enclosure in non-hazardous area	IP -42.	(iii)	Enclosure in Air conditioned area	IP-22 with suitable canopy at top to prevent ingress of dripping water.	(iv)	Outdoor type in non-hazardous areas	IP-55.	(v)	Outdoor in hazardous areas	As per requirements of the NEC Code for the location.
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(b) 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) Self-loosening protection. (iii) Resistant to thermal aging and vibration. (iv) Low and constant voltage drop. (c) Tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass. (d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide. (e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block. (f) Terminal blocks shall be provided with white marking strips/self-adhesive marker cards. Power terminals shall have protection covers. (g) At least 20 percent spare unwired terminals shall be provided for all panels/cabinets /desks /junction box etc. This shall be in addition to 20% spare wired terminals of spare IO channels and 10% wired spare modules. (h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels. (i) 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. (j) Other requirements of the terminal blocks are as follows:		

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(i) The last block 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 test plug socket to connect adjacent terminals. (v) Where more than one connection to a terminal block is required, two tier terminals shall be used. (vi) Terminal blocks shall be of different colours depending on voltage levels. 7.10.7 Nameplates and Labels (a) Each item shall have permanently attached to it, in a prominent position, a rating plate of non-corrosive material upon which is to be engraved the manufacturer's name, equipment, type/model number, range, serial number, together with details of the loading conditions under which the item of plant in question has been designed to operate. (b) Such nameplates or labels are to be of white non-hygroscopic material with engraved black lettering, or alternatively of transparent plastic material with suitably colour lettering engraved on the back. (c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.		

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(d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain (e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions. exemption 8.0 <u>METERING BASES AND CHART UNITS</u> The following system of units shall be followed for various displays and scales unless otherwise mentioned: <table border="0"> <tr> <td>(a) Pressure</td><td>:</td><td>Kg/cm².</td></tr> <tr> <td>(b) Differential Pressure</td><td>:</td><td>mm of H₂O column/Kg/cm².</td></tr> <tr> <td>(c) Draught</td><td>:</td><td>mm of H₂O column.</td></tr> <tr> <td>(d) Vacuum</td><td>:</td><td>Kg/cm² (abs)/mm of Hg column.</td></tr> <tr> <td>(e) Temperature</td><td>:</td><td>Degree Celsius (°C).</td></tr> <tr> <td>(f) Flow (Steam, Water)</td><td>:</td><td>Tonnes/hr, M³/Hr.</td></tr> <tr> <td>(g) Flow (Oil)</td><td>:</td><td>M³/Hr, Litter/Hr.</td></tr> <tr> <td>(h) Flow Air</td><td>:</td><td>Tonnes/hr/M³/Hr.</td></tr> <tr> <td>(i) Density</td><td>:</td><td>gms/c.c.</td></tr> <tr> <td>(j) Level</td><td>:</td><td>mm/%.</td></tr> <tr> <td>(k) Conductivity</td><td>:</td><td>Siemens/cm.</td></tr> <tr> <td>(l) Gas Analyzer</td><td>:</td><td>Percentage by weight or as specified in respective case.</td></tr> <tr> <td>(m) Dissolved Oxygen/Silica /Sodium</td><td>:</td><td>ppm /ppb.</td></tr> </table>			(a) Pressure	:	Kg/cm ² .	(b) Differential Pressure	:	mm of H ₂ O column/Kg/cm ² .	(c) Draught	:	mm of H ₂ O column.	(d) Vacuum	:	Kg/cm ² (abs)/mm of Hg column.	(e) Temperature	:	Degree Celsius (°C).	(f) Flow (Steam, Water)	:	Tonnes/hr, M ³ /Hr.	(g) Flow (Oil)	:	M ³ /Hr, Litter/Hr.	(h) Flow Air	:	Tonnes/hr/M ³ /Hr.	(i) Density	:	gms/c.c.	(j) Level	:	mm/%.	(k) Conductivity	:	Siemens/cm.	(l) Gas Analyzer	:	Percentage by weight or as specified in respective case.	(m) Dissolved Oxygen/Silica /Sodium	:	ppm /ppb.
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SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A

VOLUME II B

SECTION D

REV. NO. 03

DATE : 16-09-2013

SHEET 1 OF 6

1.0 SCOPE

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

2.0 CODES AND STANDARDS

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

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

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

3.0 TECHNICAL REQUIREMENTS

3.1 Pane Construction

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

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

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

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

Enclosure thickness: Not less than 3.0 mm for load bearing sections (Mounted with instruments)
2.0 mm for doors and Not less than 2.0 mm for others

Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0))

Gland plate thickness: 3.0mm

Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

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

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

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3.1.7 The class of protection shall be in accordance with IP-55 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling , de greasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.

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

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel and in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

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

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

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

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

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

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

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

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

3.2 Hazardous Area Panel Requirement

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

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

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

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

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

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

3.3 Control & Monitoring devices

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

3.3.2 Alarm Annunciator System

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

3.3.3 Relays

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

3.3.4 Timers

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

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

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

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

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

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

3.3.7 A mmeters
Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PE S-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

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

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

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

4.0 TESTING AND INSPECTION

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

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

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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

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

5.2. Mandatory Spares

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

5.3. Recommended Spares

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

6.0 DRAWINGS AND DOCUMENTS

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

1. Data Sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

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

1. Data Sheet No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate along with cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs .

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, incidental damage due

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								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	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	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	IS:2062	IS:2062 Log	Book	2	---	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062 Log	Book	2	---	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	---	
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics ^s 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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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 IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA Verification		100% BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like	1. Verification at make and Type	CR Visual		Sample	BHEL Spec. and BOM	BHEL Spec. and BOM	Log Book	2	---	---	
2	Annunciator	. Verification of Test Certificates	CR Scrutiny of Type / Routine T.Cs.		100%	Relevant IS	Relevant IS	Log Book	2	---	---	
3.	Transformers	Operation / Functional check	CR Electrical		Sample+ 100% @	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	+ for relay & contactors only
4	Lamps	. I.R.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	@ for all components except relays & contactors.
5	Switches	. H.V.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	
	PBs	6. Calibration	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	1	
	Contactors	7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	
	Relays											
	Timers											
	Space Heaters											
	Thermostat											
	Indicating meters etc.											

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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 M	isc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
2.		Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
6.0	IN PROCESS Blanking / Bending / Forming	1. Di mensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
		2. Surface defects after bending	MA Vi	sual	100%	Factory Standard	Factory Standard	Log Book	2	---	---		
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
8.0 F	ASSEMBLY Frame Assembly & Sheet fixing	1. Di mensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
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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. Pre treatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA M	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA Vi	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA Vi	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA Vi	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	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 ^s			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA Vis	ual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor MA		Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components MA		Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing MA		Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1		At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA Vi	sual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1		
		3. Components identification Marking / Name plates	MA Vi	sual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	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 ^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 1	00%	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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									P	W	V	
13. T	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3 ---		1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	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 IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

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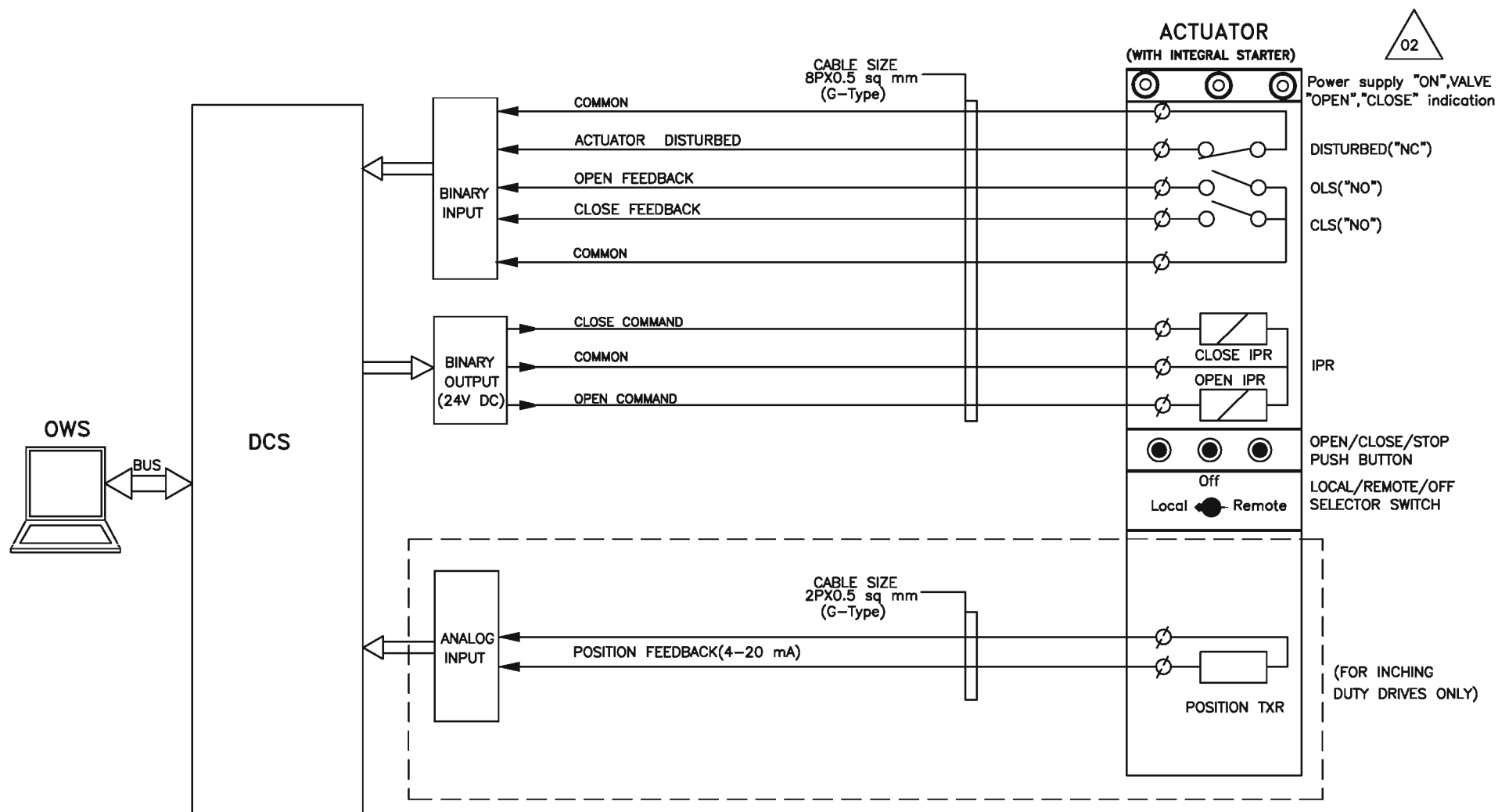
	DATA SHEET FOR LOCAL PANELS		SPECIFICATION NO.: PES-145-054A	
			VOLUME	
			SECTION	
			REV. NO. 01	DATE: 24.01.2019
			SHEET 1 OF 2	
TAG No. Qty.....				
Data Sheet No.: PES-145A-DS1-0				
Data Sheet A & B				
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT	☒ 3.0 mm (FOR FACES SUPPORTING INSTRUMENTS/TERMINALS) ☒ 2.0 mm (FOR OTHER SIDES AND TOP)	
		OTHER		
		DOOR	☒ 2.0 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
OTHER	☐			
TECHNICAL	INPUT POWER SUPPLY *		☐ 240V 50 Hz AC ☐ 220V DC ☐ 415V 3 PHASE 3W ☐ 415V 3 PHASE 4W	
	NO. OF FEEDERS		☐ ONE ☒ TWO	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____ NOS. (AS REQUIRED)	
	PAINT TYPE		☐ EPOXY ENAMEL ☒ EPOXY POWDER COATED OR BETTER (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	PANEL COLOUR (EXTERNAL)		☐ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275) . ☒ RAL 7032 (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	FINISH (EXTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☐ WHITE ☐ CREAM ☐ OFF WHITE ☒ BRILLIANT WHITE	
	FINISH (INTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		☐ IP-42 (FOR INDOOR SERVICE) ☒ IP-55 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE		☒ RELAY BASED	
	FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE		☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
	CABLE GLAND		☐ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT) *		☐ 1 Amp CT ☐ 4-20 mA	

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PES-145-054A	
				VOLUME	
				SECTION	
				REV. NO. 01	DATE: 22.03.2011
				SHEET 2 OF 2	
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		☐ FOLDED ☐ WELDED (As per requirement EDN)		
	CONSTRUCTION				
	ENCLOSURE SHEET THICKNESS	FRONT			
		OTHER			
		DOOR			
		HEIGHT			
		OTHER			
TECHNICAL	INPUT POWER SUPPLY				
	NO. OF FEEDERS				
	CONTROL SUPPLY				
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)				
	PAINT TYPE				
	PANEL COLOUR (EXTERNAL)				
	FINISH (EXTERNAL)				
	PANEL COLOUR (INTERNAL)				
	FINISH (INTERNAL)				
	CLASS OF PROTECTION				
	CONTROL HARDWARE				
	FOUNDATION ARRANGEMENT				
	WEIGHT OF PANEL (Kg.)				
	PANEL TYPE				
	CABLE GLAND				
	AMMETER (TYPE OF INPUT)				
	NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	
Shiv Kumar		Anisha B Singhal	Anisha B Singhal		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
DRIVE CONTROL PHILOSOPHY		

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



PROJECT:

1x660 MW BHUSAWAL STPP

DRG.NO.

PE-DM-415-145-I002

TITLE

DDCMIS INTERFACE FOR
BIDIRECTIONAL DRIVE

DATE

01.10.2018

REV.NO.

04

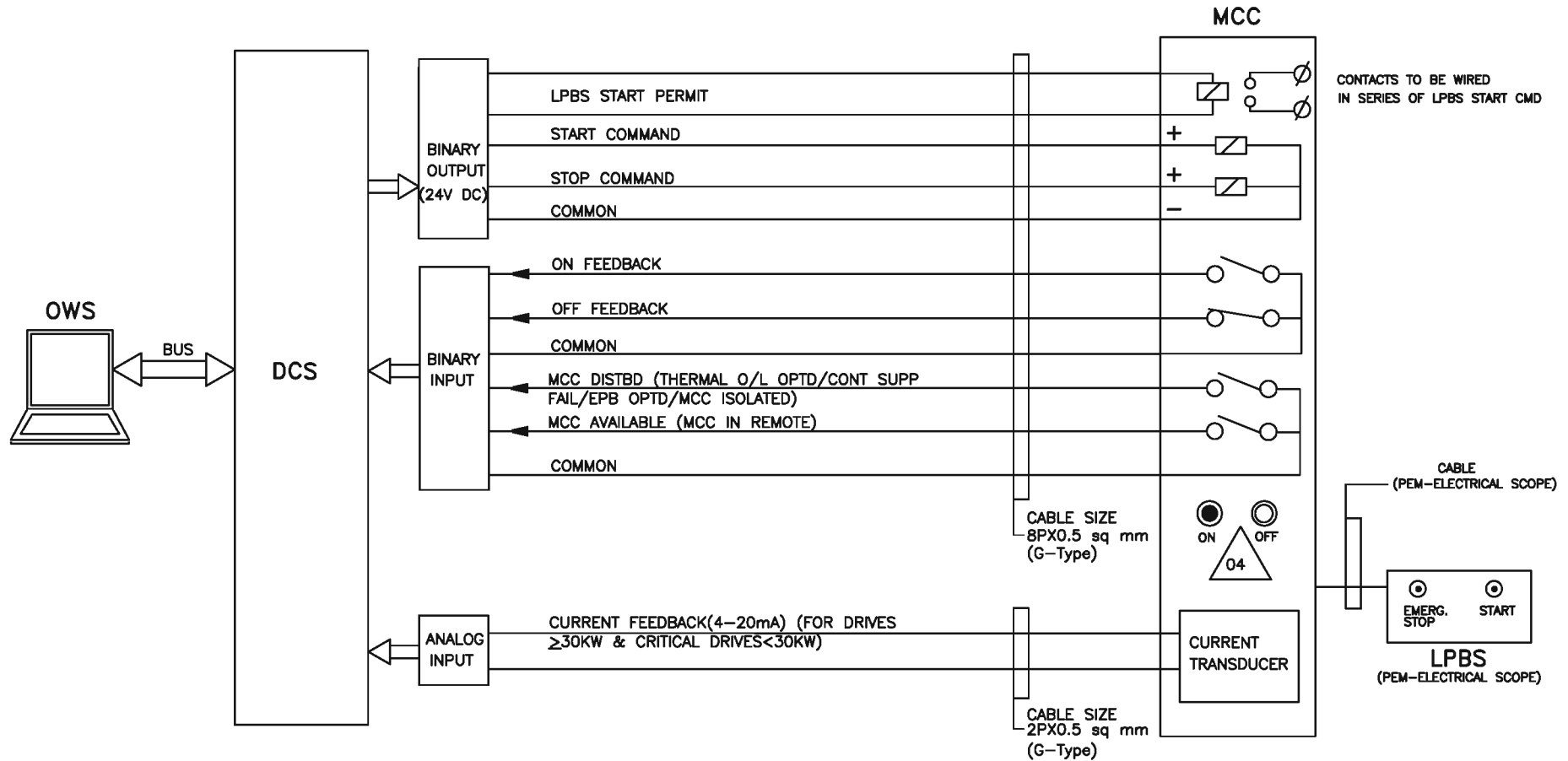
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8

OF

12

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE(CONTACTOR OPERATED)



NOTE: INTERPOSING RELAYS(IPRs) TO BE SUPPLIED ALONG WITH MCC.



PROJECT:

1x660 MW BHUSAWAL STPP

DRG.NO.

PE-DM-415-145-1002

DATE

01.10.2018

TITLE

DDCMIS INTERFACE FOR
UNIDIRECTIONAL LT DRIVE

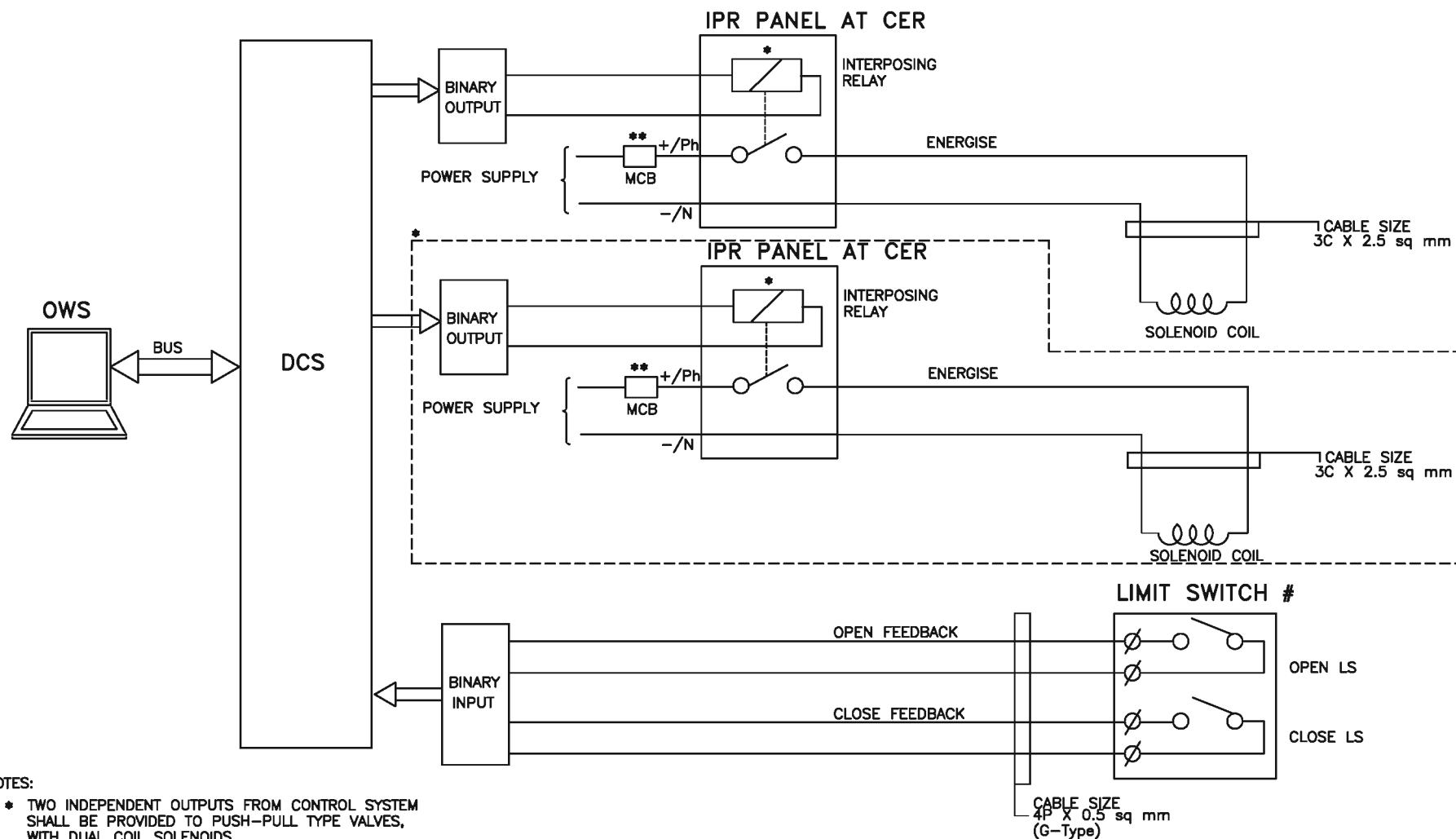
REV.NO.

04

SHT

9 OF 12

DCS 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:

1x660 MW BHUSAWAL STPP

DRG.NO.

PE-DM-415-145-1002

DATE

01.10.2018

TITLE

DDCMIS INTERFACE FOR
SOLENOID DRIVE

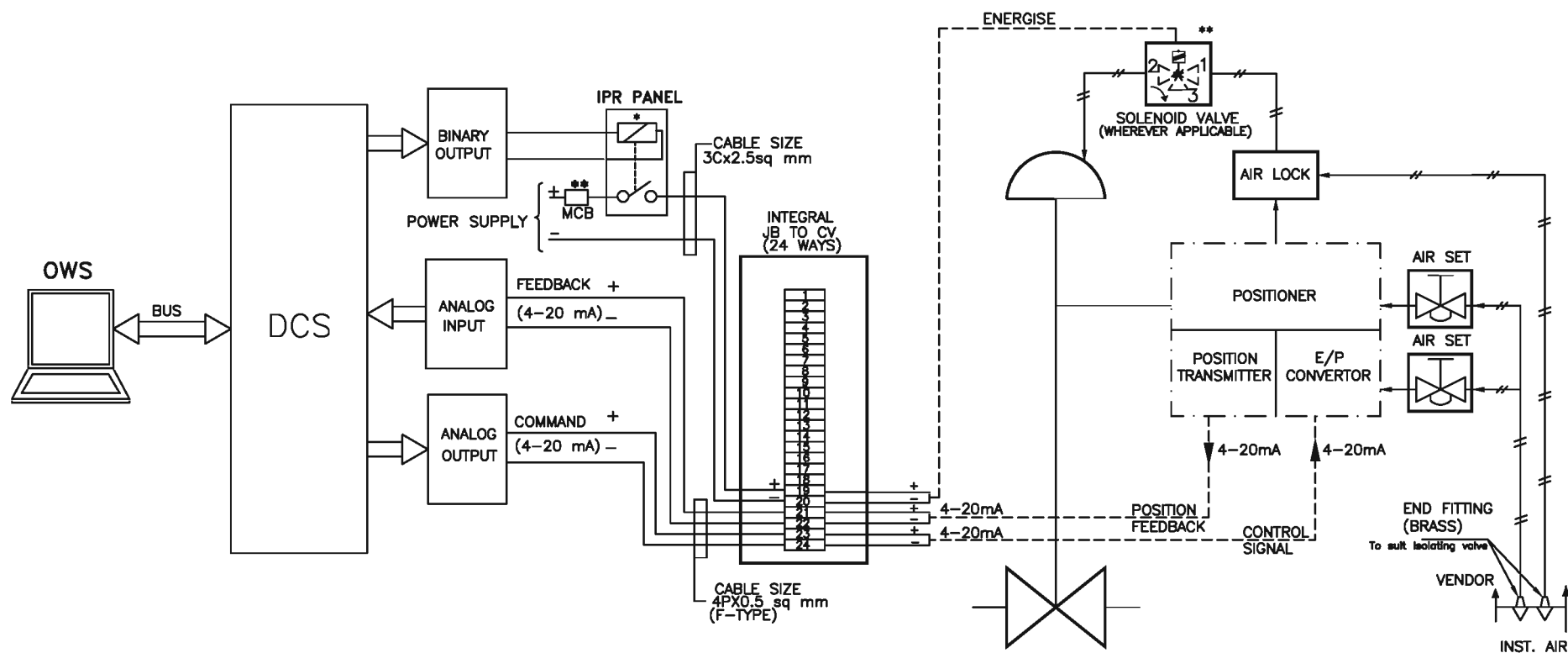
REV.NO.

04

SHT

10 OF 12

DCS INTERFACE FOR ANALOG DRIVE



NOTES:

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



PROJECT:

1x660 MW BHUSAWAL STPP

DRG.NO.

PE-DM-415-145-1002

TITLE

TYPICAL HOOK-UP DIAGRAM
ANALOG DRIVE

DATE

01.10.2018

REV.NO.

04

SHT

12 OF 12

APPLICABLE CODES AND STANDARDS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
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The required quantities of cable accessories shall be similarly estimated on the basis of number of terminations and proposed routing of the cables and shall be included in the offer allowing a positive allowance of at least 30% for each accessory. The exact quantity of different accessories shall be specified in the offer. Any shortfall in the quantity of accessories observed during actual laying shall be compensated at no extra cost. 5.0 <u>PROVEN PRODUCT</u> 5.1 The offered model of DCS, Microprocessor based control system must have been successfully supplied, erected, tested and commissioned as complete station Control & Instrumentation system for at least two units of capacity not less than 600 MW supercritical Thermal Power Station(s) with reheat type pulverized coal fired boiler. Further, these units should be in successful operation for a minimum period of two (2) years. 5.2 Similarly, all other C&I equipment/PLC/systems/sub-systems/instruments and accessories in the power cycle shall also be of make and model whose guaranteed and trouble-free performance has been proven at least for two (2) years in not less than two (2) different reheat type pulverized coal fired units of unit size not less than 500 MW. 5.3 Bidder shall furnish required information to fully satisfy Owner regarding successful operation and high reliability of products/systems furnished. 6.0 <u>CODES AND STANDARDS</u> 6.1 Items such as thermowells, control valves, flow elements and other in line devices in high and medium pressure steam, feed water and similar services, which fall under the purview of Indian Boiler Regulation Act shall be either certified by IBR or shall be certified by authorities acceptable to IBR. It shall be responsibility of Bidder to obtain the necessary approval of the concerned Authority/Chief Inspector of Boiler for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification. 6.2 Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall be applicable.		

CONSULTANT : PROCON ENGINEERS

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6.2.1 Temperature Measurement (a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). (b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982. (c) Temperature Measurement by electrical resistance thermometers - IS: 2806. (d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760. 6.2.2 Pressure Measurement (a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964). (b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996. 6.2.3 Flow Measurement (a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II. (b) Measurements of fluid flow in closed conduit - BS 1042. 6.2.4 Electronic Measuring Instruments and Control Hardware (a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319. (b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5/1974. (c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1/1975. (d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).		

CONSULTANT : PROCON ENGINEERS

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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
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(e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4. (f) Printed circuit boards - IPC TM-650, IEC 326C. (g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973. (h) Edge socket connectors - IEC 130-11. (i) Requirements and methods of testing of wire wrap terminations- DIN 41611 Part-2. (j) Dimensions of attachment plugs and receptacles- ANSI C73-1973. (Supplement ANSI C73a – 1980. 6.2.5 Instrument Switches and Contacts (a) Contact Rating - AC services NEMA ICS Part-2 125, A-600. (b) Contact Rating - DC services NEMA ICS Part-2 125, N-600. 6.2.6 Enclosures (a) Enclosures for Industrial Controls and Systems–NEMA ICS-6-110.15 through 110.22. (b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972). 6.2.7 Apparatus, Enclosures and Installation Practices in Hazardous Area (a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978. (b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11. (c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
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(d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.		
6.2.8	Sampling System	
(a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316. (b) Submerged helical coil heat exchangers for sample coolers - ASTM D11-98.		
6.2.9	Annunciator	
(a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1. (b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.		
6.2.10	Interlocks, Protections	
(a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13. (b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974. (c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/ 1973. (d) Turbine water damage prevention - ASME-TDP-1-1980. (e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.		
6.2.11	UPS System	
(a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
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(b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13. (c) Surge withstand capability tests - ANSI C 70.90 A/1971, IEC-255.4. (d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations - -IEEE-485. (e) Battery: IEEE Std. 1106/IS, 10918, BS 6920-II: 1984, IS 1652, IEC 896-1987. (f) For Lead acid plant type battery selection & sizing : IEEE Std. 485:1997 6.2.12 Control Valves (a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972. (b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972. (c) Control Valve seat leakage – ANSI / FCI 70.2. (d) Face to face dimensions of Control Valves - ANSI B16.10. (e) Control Valve Capacity Test Procedure – ISA – S75.02. 6.2.13 Instrument Tubing (a) Seamless Carbon Steel Pipe - ASTM-A-106. (b) Forged carbon steel fittings - ASTM-A-105. (c) Dimensions of fittings - ANSI-B16.11. (d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1. (e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982. (f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
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(g) Seamless Alloy Steel Pipe ASTM A 335 P22. (h) Seamless Stainless Steel Pipe ASTM A-312 TP 316. 6.2.14 Cables (a) Thermocouple extension wires/cables - ANSI MC96.1. (b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402. (c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422. (d) Requirements of vertical tray flame test - IEEE 383. (e) Standard specification for finned soft or annealed copper wire for electrical purpose - ASTM B33. 6.2.15 Electronic Cards, Subassemblies and Components (a) Unpackaged. (i) Vibration : IEC-68.2.6 (ii) Shock : IEC-68.2.27 (iii) Drop & Topple : IEC-68.2.31 (b) Packaged Vibration, Drop & Static Compression – NSTA. (c) Electromagnetic Compatibility (i) Electrical Fast Transient : IEC-801.4 (ii) Surge Withstand : IEC-255.4		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO MAHARASHTRA STATE POWER GENERATION CO. LTD.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
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	(iii) Radiated Electromagnetic Field : IEC-801.3 (iv) Electrostatic Discharge : IEC-801.2 (v) Electromagnetic Emissions : VDE 0871, Class-B	
6.2.16	Cable Trays, Conduits (a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979. (b) Galvanizing of carbon steel cable trays - ASTM A-386.	
7.0	<u>DESIGN CRITERIA</u>	
	This section lays down the general design criteria to be adapted in designing the instrumentation and control system of the plant.	
7.1	<u>GENERAL REQUIREMENTS</u>	
7.1.1	Instrumentation, control and automation devices and accessories shall be designed with the following considerations: (a) Stable in spite of temperature fluctuations. (b) Able to withstand high humidity. (c) Weather proof. (d) Dust proof. (e) Corrosion resistant. (f) Erosion resistant. (g) Able to withstand high vibration.	

CONSULTANT : PROCON ENGINEERS

SPECIFICATION FOR QUALITY ASSURANCE & TESTING



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

CHECK LIST FOR TRANSMITTER

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

Legend :

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

Note :

- 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 correlation are not available manufacturer'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 TEMPERATURE ELEMENT

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 No./TAG No.						
	PROCESS CONNECTION						
2	STABILITY			P	W	V	
3	INSULATION RESISTANCE			P	W	V	
4	ENCLOSURE CLASS			P	W	V	
5	RESPONSE TIME			P	W	V	
7	ACCURACY			P	W	V	
8	HYDROSTATIC TEST			P	W	V	
9	ELECTRICAL CHARACTERISTIC OF SENSOR (CONTINUITY OF T/C WIRES & INSULATION RESISTANCE OF RTD LEADS w.r.t. BODY			P	W	V	
10	TEMP CURVES / CHARTS			P	V	V	
11	AMBIENT TEMP. EFFECT CHECK			P	W	V	
12	HV TEST			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.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.
- IBR certificate to be provided, if applicable



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

CHECK LIST FOR TEMPERATURE GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	DIAL SIZE						
	MODEL NO./TAG NO./TYPE						
	RANGE/SCALE						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	HYSTERESIS						
3	OVER TEMP. TEST	P		W	V		
4	AMBIENT TEMP. COMPENSATION CHECK	1 OF TYPE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	THERMOWELL						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	THERMOWELL	SEE NOTE-1 BELOW	AS PER APPD DWG		V	V	
	MATERIAL TC & DIMN. CHECK						
	HYD.TEST						
	OVER RANGE TEST						

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 %.
- IBR certificate to be provided if called for in specn.
- 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 PRESSURE & DP GAUGE

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

Legend :

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

Note :

- 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 :

** 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.

FORM NO. PEM-6666-0

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (Mechanical Auxiliary Packages)		SPECIFICATION NO.:	
			VOLUME	
			SECTION	
			REV. NO.	DATE:
			SHEET 1	OF 1
Data Sheet No.: PE-CL-999-145-1026-0				

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				M	C	B	
1.0	CHECKS FOR VISUAL, MODEL TAG NO.	SEE NOTE-1 BELOW	APPROVED TECHINCAL REQUIREMENT/ DATA SHEET	P	W	V	MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATERIAL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
2.0	PROCESS CONNECTION	-do-		P	W	V	
3.0	ACCURACY	-do-		P	W	V	
4.0	REPEATEABILITY	-do-		P	W	V	
5.0	HYSTERISIS	-do-		P	W	V	
6.0	EFFECT OF TEMP VARIATION ON ACCURACY	-do-		P	W	V	
7.0	SPAN /ZERO ADJUSTMENT	ONE/TYPE		P	W	V	
8.0	EFFECT OF SUPPLY VOLTAGE VARIATION	ONE/TYPE		P	W	V	
9.0	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
10.0	BURN IN TEST	ONE/TYPE		P	W	V	
11.0	DEGREE OF PROTECTION	ONE/TYPE		P	W	V	

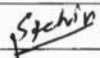
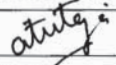
LEGEND:

M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

- QUANTUM OF CHECK SHALL BE AS BELOW
100 % - BY MANUFACTURER
RANDOM FOR EACH TYPE - BY BHEL & CUSTOMER
- MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.
- IN CASE OF IMPORTED ITEMS CONTRACTORS SHALL REVIEW TC's AND NOT INSPECT.

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	SACHIN SRIVASTAVA	DILIP JEJURIKAR	ALKA TUTEJA
SIGNATURE			
DATE	30.09.08	30.09.08	30.09.08



**CHECK LIST FOR
PRESSURE / DIFFERENTIAL PRESSURE SWITCH
(Mechanical Auxiliary Packages)**

SPECIFICATION NO.:
VOLUME
SECTION
REV. NO. DATE:
SHEET 2 OF 2
Data Sheet No.: **PE-CL-999-145-I031-0**

SL NO	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS	
				P	W	V		
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT/ DATA SHEET/ RELEVANT STANDARD / MANUFACTURER CATALOGUE				MFR TO CARRY OUT ROUTINE TEST ON 100%.	
	1.1 MODEL NO/TAG NO	100%		M	C	C		
	1.2 RANGE/SCALE	100%		M	C	C		
	1.3 END CONNECTION	100%		M	C	C		
	1.4 SWITCH CONTACT RATING & NOS	100% M			C	C		
2.0	CALIBRATION						WHEN TC FOR MATERIAL FOR THE PROJECT NOT AVAILABLE , COMPLIANCE CERTIFICATE TO BE PROVIDED BY THE MANUFACTUR ER.	
	2.1 REPEATABILITY	100%		M	C	B		
	2.2 DIFFERENTIAL	100%		M	C	B		
	2.3 SET POINT ADJUSTMENT	100% M			C	B		
3.0	OVER PRESSURE & LEAK TEST	100% M			C	C		
4.0	REVIEW OF T.C. FOR MATERIAL OF--							
	5.1 SENSOR	FOR LOT		--		B		
	5.2 MOVEMENT			-	-	B		
	5.3 HOUSING			-	-	B		
5.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST		-	-	B		
6.0	REVIEW OF T.C. FOR MICRO SWITCH	FOR LOT	-	-	B			
7.0	ACCESSORIE S AS APPLICABLE	100% M		C	C			

LEGEND:

M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

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 :

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

Note :

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

 PEM :: C&I		QUALITY PLAN FOR FLOW ORIFICE PLATE ASSEMBLY						QUALITY PLAN NO.: PE-QP-415-145-I005				
								VOLUME IIB				
								SECTION D				
								REV. NO. 02				

 PEM :: C&I		QUALITY PLAN FOR FLOW ORIFICE PLATE ASSEMBLY						QUALITY PLAN NO.: PE-QP-415-145-I005				
								VOLUME IIB				
								SECTION D				
								REV. NO. 02		DATE: 07.12.18		
								SHEET 7		OF 7		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
4.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	SP / MS	SP / MS	----	3/2	----	----	Refer Note 4

NOTE:

1. All test reports & dimension reports shall be verified by BHEL wherever verification is by BHEL at the time of Final Inspection. Positive material identification testing shall be performed by vendor and the same shall be witnessed by BHEL.
2. Minimum 2 coats of primer paint to be applied before dispatch.
3. CALIBRATION Test to be carried out at IIT-DELHI / FCRI or BHEL approved laboratory.
4. Sea Worthy packing, if applicable.

LEGEND: * CR - Critical characteristics IR - Inspection Reports DS – Data Sheet MR- Manufacturer records \$ P - Agency Performing the Test. 1- BHEL4-MAHAGENCO
 MA - Major characteristics TC - Test Certificates SP – Tech. Spec. MS- Manufacturer standards W - Agency Witnessing the Test. 2 - Vendor
 MI - Minor characteristics AP – Approved Drawings/doc V - Agency Verifying the Test. 3 - Sub-vendor

MANDATORY SPARES

		MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: II
		BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 9
REV: R0		MASTER SPECIFICATIONS	Page 405 of 555
<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>	
	measurement used.		
3.0	<u>MEASURING INSTRUMENTS</u>		
3.1	<u>ELECTRONIC TRANSMITTERS</u>		
3.1.1	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level etc.)	10% or 2 no. of each type and model, whichever is more	
3.1.2	Electronic cards / PCB's for each type and model and model of transmitters	10% or 5 nos. of each type, whichever is more	
3.2	<u>TEMPERATURE ELEMENTS</u>		
3.2.1	RTDs of each type & length	10% or 2 nos. whichever is more	
3.2.2	Thermocouples of each type like K-type, R-type, metal etc and length	10% or 2 nos. whichever is more	
3.2.3	Thermowell for T/C & RTDs	10% or 1 no. of each type, rating, length used in the system whichever is more	
3.2.4	Process actuated switch devices Including all types of pressure, differential pressure, flow, temperature, differential temperature, level switch devices	10% or 1 no. of each type and model whichever is more	
3.3	<u>INDICATORS/RECORDERS</u>		
3.3.1	Digital Indicators of each model, type & range (including relevant digital indicators of electrical system)	10% or 2 nos. min. whichever is more	

CONSULTANT : PROCON ENGINEERS

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
3.3.2	Vertical Indicators of each type & model	5% or 1 no. of each model whichever is more
3.3.3	Recorders for each type and model	5% or 1 no. whichever is more.
3.3.4	Consumables for continuous recorders Charts Ink capsules	25 rolls per recorder/ 25 nos per recorder/ 20 nos. per recorder / Ink Pads /Pens.
3.3.5	Consumables for multi point recorders	
(a)	Charts	5 nos. per recorder
(b)	Ink pads	5 nos. per recorder
(c)	Print mechanism/ print head assembly	10% or 5 nos. of each type whichever is more
3.3.6	Level transmitters (displacer type)	
(a)	Electronic cards / PCB's of level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(b)	Level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(c)	Electronic water level indicator	10% or 2 nos. min. whichever is more
3.3.7	PD type flow transmitters	10% of total quantity used or 1 for each type/rating whichever is more
3.4	<u>SWITCHES</u>	
3.4.1	Switches (Pressure, DP, Level, Flow, Temperature etc)	10% of each type of total nos. used in the system or minimum 1 no. of each type, model & range whichever is more

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>	
3.5	Rotameter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more	
3.6	<u>SOLENOID VALVE</u>	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more	
3.6.1	Assembly	10% of total quantity used or minimum 2 no. of each type whichever is more	
3.6.2	Coil	10% of toatal quantity used or 5 no. whichever is more	
3.7	E/P Converter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more	
3.8	<u>SPECIAL INSTRUMENTS</u>		
3.8.1	Nucleonic /non-nucleonic density meter, solid flow meter etc.	1 no. and spare parts as per manufacturer	
3.9	Electrical Transducers	10% of total quantity used or minium 1 no. of each type and range whichever is more	
4.0	<u>POWER SUPPLY SYSTEM</u> <u>(24 V DC POWER SUPPLY SYSTEM)</u>		
4.1	Silicon controlled thyristors, diodes power transistors	100%	

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>	
4.17	Rubber gloves	1 no.	
4.18	Voltmeter for measuring cell voltage (centre zero type)	1 no.	
4.19	Thermometer	1 no.	
4.20	Insulated socket spanner with handle	1 no.	
5.0	<u>PROCESS CONNECTION PIPING</u> (for impulse piping /tubing, sampling piping/ tubing and air supply piping as applicable)		
5.1	Valves of all types and models	10% or 2 no. of each type, class, size and model whichever is more.	
5.2	2 way, 3way, 5way valve manifolds	10% or 2 no. of each type, class size and model whichever is more.	
5.3	Fittings	10 nos. of each type	
5.4	Purge meters	10 % of each model or 2 Nos. whichever is more	
5.5	Filter regulators	10% of each model or 2 Nos. whichever is more	
5.6	Impulse pipe & tubing of all type	20 mtrs each type & size	
5.7	Impulse line root valve	10% of total quantity used or 4 no. whichever is more for each type and rating of each size	
5.8	SS tube	40 mtrs of each type/size	
5.9	Fitting for SS tube	40 nos. of each type/size	

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6.0	<u>INSTRUMENTATION CABLE, INTERNAL WIRING AND ELECTRICAL FIELD</u>	
6.1	Pre fabricated cable of each type	10% of installed quantity
6.2	Pre fabricated cable connector	10% or 1 no. of each type and model, whichever is more.
6.3	Other cables	10% of each type, pair and size of actual installed quantity
7.0	<u>ELECTRICAL ACTUATORS</u>	
7.1	Actuators	10% or 1 no. of each type, model and rating, whichever is more.
7.2	Power unit for modulating actuator	10% or 2 nos. of each type, whichever is more.
7.3	DC-DC unit/power pack units	10% or 2 nos. of each type, whichever is more.
7.4	Electronic cards	10% or 5 nos. of each type, whichever is more
7.5	Brake assembly	10% or 2 nos. of each type, whichever is more..
7.6	Brake coils	10% or 2 nos. of each type whichever is more.
7.7	Position feed back transmitters	10% or 2 nos. of each type whichever is more.
7.8	Control unit	10% or 2 nos. of each type whichever is more
7.9	Torque and limit switch assembly of each unit	10% or 2 nos. of each type, whichever is more.
7.10	O-ring	1 set of each size

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>	
7.11	Motor	1 no. of each type & rating	
7.12	Auxiliary contact	10% of total quantity used or 2 nos. whichever is more for each type and rating of each size	
7.13	Seal kit	1 set of each type & size	
8.0	<u>PLC CONTROL SYSTEM FOR PLANT AUXILIARIES & OFF-SITE PLANTS</u>		
8.1	CPU Card	10% of total quantity of each type used in all systems.	
8.2	Communication Processor Module	10% of total quantity of each type used in all systems.	
8.3	Binary Input Card	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	
8.4	Pulse Input Card	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
8.5	Analog Input Card (4 to 20 mA type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
8.6	Analog Input Card (RTD input type)	10% of total nos. used in the system or minimum 2(two) nos. whichever is more.	
8.7	Binary Output Card for contact	10% of total nos. used in the system or minimum 4(four) nos. whichever is more.	

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
8.26	PLC Network End connector	10% of total quantity for each System
8.27	MCB	1 no. of each type and rating
9.1	<u>CONDUCTIVITY</u>	
9.1.1	Conductivity Sensor/cell for each type of Cell Constant	20% of the total no. used in the system or minimum 2(two) nos. whichever is higher.
9.1.2	Conductivity Transmitter Complete Set	20% of the total no. used in the system or minimum 2(two) nos. whichever is higher.
9.2	<u>pH</u>	
9.2.1	pH Sensor	20% of the total no. used in the system or minimum 2(two) nos. whichever is higher.
9.2.2	pH Transmitter Complete Set	20% of the total no. used in the system or minimum 2(two) nos. whichever is higher.
9.2.3	Sensor recharger	20% of the total no. used in the system or minimum 2(two) nos. whichever is higher.
9.3	<u>SODIUM ANALYSER</u>	
9.3.1	Sodium Analyser Electrode	1 (one) no.
9.3.2	Critical Electronic spare part for Sodium Analyser Analyser/Monitor	1 (one) no. each type
9.3.3	Reagent container	1 no.
9.3.4	Refurbishment kit for sodium analyser	1 no.

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 MAHAGENCO MAHARASHTRA STATE POWER GENERATION CO. LTD.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: II
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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
9.3.5	Consumable kit/ Chemical Reagent for Sodium Analyser	For maintaining the system for 1(one) Year continuous operation
9.4	<u>SILICA ANALYSER</u>	
9.4.1	Critical Electronic spare part for Silica Analyser/Monitor	1(one) no. each type
9.4.2	Reagent container	1 no.
9.4.3	Cuvette assy for silica	1 no.
9.4.4	Pump motor for silica	1 no.
9.4.5	Tube replacement kit	1 set
9.4.6	Fuses of each type	2nos. each
9.4.7	Consumable kit/ Chemical Reagent for Silica Analyser	For maintaining the system for 1(one) Year continuous operation
9.5	<u>HYDRAZINE ANALYSER</u>	
9.5.1	Critical Electronic spare part for Hydrazine Analyser/Monitor	1(one) no. each type
9.5.2	Cell Recharge kit	1 no.
9.5.3	Porus Disc	1 no.
9.5.4	Seal rings	1 set
9.5.5	Fuses of each type	2nos. each
9.5.6	Consumable kit/ Chemical Reagent for Hydrazine Analyser	For maintaining the system for 1(one) Year continuous operation
9.6	<u>DISSOLVE OXYGEN</u>	
9.6.1	Dissolve Oxygen Sensor Complete Set	1(one) no.

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>	
9.6.2	Dissolve Oxygen Analyser Complete Set	1(one) no.	
9.7	<u>PHOSPHATE ANALYSER</u>		
9.7.1	Electrode	1(one) no.	
9.7.2	Critical Electronic Spare Parts for Phosphate analyser/monitor	1(one) no. each MPC	
9.7.3	Consumable kit/Chemical Reagent for Phosphate Analyser	For maintaining the system for 1(one) year continuous operation	
9.8	<u>OTHER HARDWARE</u>		
9.8.1	Stainer each type	2(two) nos.	
9.8.2	Sample Cooler	2(two) nos.	
9.8.3	High Pressure Reducing Valve	5(five) nos.	
9.8.4	Cation column	5(five) nos.	
9.8.5	Pressure Gauge, Pressure Switch, Temperature Gauge, Temperature Switch, Isolating Valve, Solenoid Valve, Rota Meter etc.	10% of total quantity of each item and type/rating used in the system or minimum 1(one) no. whichever is higher.	
9.8.6	Annunciation System		
(a)	Each type of PCB	1(one) No. each	
(b)	Lamp Box with Facia & Lamps (LED type)	5(five)Nos.	
(c)	Hooter	1(one) No.	
9.8.7	Auxiliary/Power Contactor, Push Button, Indicating Lamp, Fuse etc. for Chiller Unit	10% of total quantity of each type of items used in the system or minimum 2(two) nos. whichever is more.	

CONSULTANT : PROCON ENGINEERS

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>	
9.9	<u>CHILLER UNIT</u>		
9.9.1	Auxiliary/Power Contactor, Push Button, Indicating Lamp, Fuse, thermal overload etc. for Chiller Unit	10% of total quantity of each type of items used in the system or minimum 1(one) nos. whichever is more.	
9.9.2	Pressure Switch, Temperature Switch, Isolating Valve, Solenoid Valve, Thermostat etc.	10% of total quantity of each type of items used in the system or minimum 1(one) nos. whichever is more.	
10.0	<u>FLUE GAS ANALYZERS</u>		
10.1	Analyzers spares like transmitter lens & receiver lens, protection windows for transmitters & receivers, integral pressure & temp. sensors, signal processing unit	1 no. of each type receiver	
10.2	Light source and detector unit for opacity, Nox, Sox, CO	1 set of each type	
10.3	Cooling and purging air blower unit	1 for each type and set of filters	
10.4	Electronic modules comprising of at least 1 no. of each type of module for each analyzer	1 set	
10.5	Zirconia oxygen analyzer	1 set	
11.0	<u>RADAR TYPE LEVEL TRANSMITTER</u>		
11.1	Transmitter/Receiver	10% or 1 no. of each type transmitter/ receiver	
11.2	Electronic card	10% or 1 no. of each type electronic card	

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	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: II
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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
17.0	<u>CONTROL PANEL AND LOCAL/REMOTE CONTROL DESK (AS APPLICABLE)</u>	
17.1	Recorder	1(one) No. each type and model
17.2	Bar graph indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
17.3	Digital indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
17.4	Mosaic/Conventional Type Push button Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.5	Mosaic Type Push button Station with LED Indication	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.6	Mosaic Type LED Indication Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.7	Simaphore Indicator	2(two)Nos. each type
17.8	<u>ANNUNCIATION SYSTEM</u> (For offsite / Auxiliary Plants)	
17.8.1	Each type of PCB (for non-PLC driven system)	1(one) No. each

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: II
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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>	
17.8.2	Lamp Box with Facia & Lamps (LED type)	10% with minimum 2 nos.	
17.8.3	Hooter	1(one) No.	

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
29.7	Solenoid Coil for Pneumatic type Power Cylinder	5Nos. for each type & ratings
29.8	Position Limit Switch for Pneumatictype Power Cylinder	10Nos. for each type & ratings
29.9	Air Lock Relay	10Nos. for each type
29.10	Signal Air Booster Unit	2Nos. for each type
30.0	<u>MANDATORY SPARES NOT COVERED ABOVE</u>	Bidder to supply 10% electronic modules/ cards or any other electronic components required for system such as annunciation system for offsite/auxiliary plant, online condensate tube cleaning system, ambient air monitoring system, plant simulator.

CONSULTANT : PROCON ENGINEERS

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
DRAWINGS		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
INSTRUMENT INSTALLATION & HOOKUP DIAGRAM		

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	BJD SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section - 1
REV: R0	CONTROL & INSTRUMENTATION	Page 61 of 718

9.0

PROCESS CONNECTION & INSTRUMENT HOOK UP

9.1

Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel. Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.

9.2

Isolation and blowdown drain valves adequate for duty and capable of withstanding continuous design condition of main process shall be provided. Instrument blow down valve near to the instrument shall be of gradual opening type. For process pressure equal or above 40 kg/ sq.cm double blowdown valves shall be used connecting to blowdown header. Instrument manifold /gauge valve shall be installed close to the instrument.

9.3

The nominal size of the takeoff connections on line shall not be less than NPS ½" for source conditions not in excess of either 900 psi or 425°C and NPS ¾" (for adequate physical strength) for design conditions exceed either of these limits. Where the size of the main is smaller than the limits given above, the takeoff connections shall not be less than the size of the main line.

9.4

Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards. Table below indicates the type of connection generally to be used.

SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE
(a)	Level Instruments		
	(i) Internal Displacer	4" – Flanged.	4" – Flanged.
	(ii) External Displacer	2" – Flanged.	2" – Flanged.
	(iii) Level gauge	¾" – Flanged.	¾" – Flanged.

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: V																																
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section - 1																																
REV: R0	CONTROL & INSTRUMENTATION		Page 62 of 718																																
	<table><tr><th>SR. NO.</th><th>INSTRUMENTS</th><th>EQUIPMENT/PIPE SIDE</th><th>INSTRUMENT SIDE</th></tr><tr><td></td><td>(iv) DP Type</td><td>½" (min.) - welded 1" - welded for vessel like HP heaters, LP heaters, De-aerator etc. application.</td><td>½"- NPT.</td></tr><tr><td></td><td>(v) External cage Level switch</td><td>1"- welded.</td><td>1"- welded.</td></tr><tr><td>(b)</td><td>Flow Instruments</td><td></td><td></td></tr><tr><td></td><td>(i) DP Type</td><td>½" - welded in general. 1" - welded for high pressure/ temperature main steam, feed water, PRDS etc. application.</td><td>½" - NPT.</td></tr><tr><td>(c)</td><td>Pressure Instruments</td><td></td><td></td></tr><tr><td></td><td>(i) Conventional</td><td>½" (min.)-welded 1"- welded for high pressure/ temperature main steam, feed water, PRDS etc. application.</td><td>½" - NPT.</td></tr><tr><td></td><td>(ii) Diaphragm type-HFO application</td><td>3"- Flanged.</td><td>3"- Flanged.</td></tr></table>	SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE		(iv) DP Type	½" (min.) - welded 1" - welded for vessel like HP heaters, LP heaters, De-aerator etc. application.	½"- NPT.		(v) External cage Level switch	1"- welded.	1"- welded.	(b)	Flow Instruments				(i) DP Type	½" - welded in general. 1" - welded for high pressure/ temperature main steam, feed water, PRDS etc. application.	½" - NPT.	(c)	Pressure Instruments				(i) Conventional	½" (min.)-welded 1"- welded for high pressure/ temperature main steam, feed water, PRDS etc. application.	½" - NPT.		(ii) Diaphragm type-HFO application	3"- Flanged.	3"- Flanged.		
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	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: V																				
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section - 1																				
REV: R0	CONTROL & INSTRUMENTATION		Page 63 of 718																				
<table><tr><th>SR. NO.</th><th>INSTRUMENTS</th><th>EQUIPMENT/PIPE SIDE</th><th>INSTRUMENT SIDE</th></tr><tr><td>(d)</td><td>Temperature Instruments</td><td></td><td></td></tr><tr><td></td><td>(i) Thermowell</td><td>Generally - M 33 X2 (M). 1½" Flanged- For air /FG path application.</td><td>½" NPT.</td></tr><tr><td>(e)</td><td>Analyzer</td><td></td><td></td></tr><tr><td></td><td>(i) Liquid analyzer</td><td>½"- 1" – welded.</td><td>½".</td></tr></table>				SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE	(d)	Temperature Instruments				(i) Thermowell	Generally - M 33 X2 (M). 1½" Flanged- For air /FG path application.	½" NPT.	(e)	Analyzer				(i) Liquid analyzer	½"- 1" – welded.	½".
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	(i) Liquid analyzer	½"- 1" – welded.	½".																				
9.5	Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.																						
9.6	Separate stubs and take-off points with thermo well/root valves shall be provided for performance guarantee test.																						
9.7	Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.																						
9.8	Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.																						
9.9	Instrument blow down header shall in no case be lower than the material grade ASTM A 106 Gr. C.																						
9.10	Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.																						
9.11	Expansion loop shall be provided at least at every 2.5 meter interval without affecting the gradient of slope in long run impulse pipe to avoid stress on the piping.																						

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	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
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9.12	Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 °C or more.	
9.13	Orientation of tapplings shall be as follows : (a) For liquid service within 45° at lower half of the pipe horizontal plane. (b) For gas service within 90° at upper half of the pipe horizontal plane. (c) For steam service within 45° at upper half of the pipe horizontal plane. As a rule tap orientation of high and low pressure side should be parallel and symmetrical.	
9.14	Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.	
9.15	Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid.	
9.16	Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.	
9.17	Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316H or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.	

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	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
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10.0	<u>POWER SUPPLY SYSTEMS</u> 10.1 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources. 10.2 Type of power supply systems envisaged are as follows: (a) 240V AC UPS. (b) 24V DC battery system. The battery system shall be dual floating with each stream having its own float cum boost charger. Care shall be taken so that the control system is not damaged during boost charging and also that the cables are properly sized so that the voltage drop does not cause the terminal voltage at the consumer end to fall below the minimum recommended value.	
11.0	<u>ENVIRONMENTAL CONSIDERATIONS</u> 11.1 I&C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. C&I system shall be designed considering all the operating conditions which may be encountered during installation and operation.	
11.2	<u>TEMPERATURE</u> 11.2.1 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment.	
11.3	<u>HUMIDITY</u> I&C system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor should water be allowed to be admitted through conduit entering the cabinets from top or sides.	

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11.4	<u>ATMOSPHERIC CONTAMINATION</u>	
	Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO ₂ and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.	
11.5	<u>VIBRATION</u>	
	Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, I&C equipment shall be installed away from the vibration zone.	
11.6	<u>LIGHTNING</u>	
	Protection against lightning shall be considered by providing proper grounding, metal oxide arrestors, spark gap lightning arrestor, optical isolator and isolation transformer.	
12.0	<u>SECURITY</u>	
2.1	Door lock shall be provided in all Panels, Cabinets and Enclosures.	
12.2	System mode key switch or password to prevent tampering of system program.	
12.3	Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet/separate rack for redundant controller and redundant IO modules.	

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NOTES:

1. PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/ TEMPERATURE REQUIREMENT. FOR LINE PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ. CM. 2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.
2. MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY. ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION AND SPECIFICATION OF CONTROL & INSTRUMENTATION.
3. DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB SCH 80.

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PROCON ENGINEERS
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TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

DIV INST.

DR P.N.Z.

CH D.J.P.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

DWG.NO.PE-189-IN-SK-8003 (Sht. 2 of 20) PO

G.A. DRAWING – TRANSMITTER RACK

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(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

G.A. DRAWING-TRANSMITTER RACK

SCALE ~

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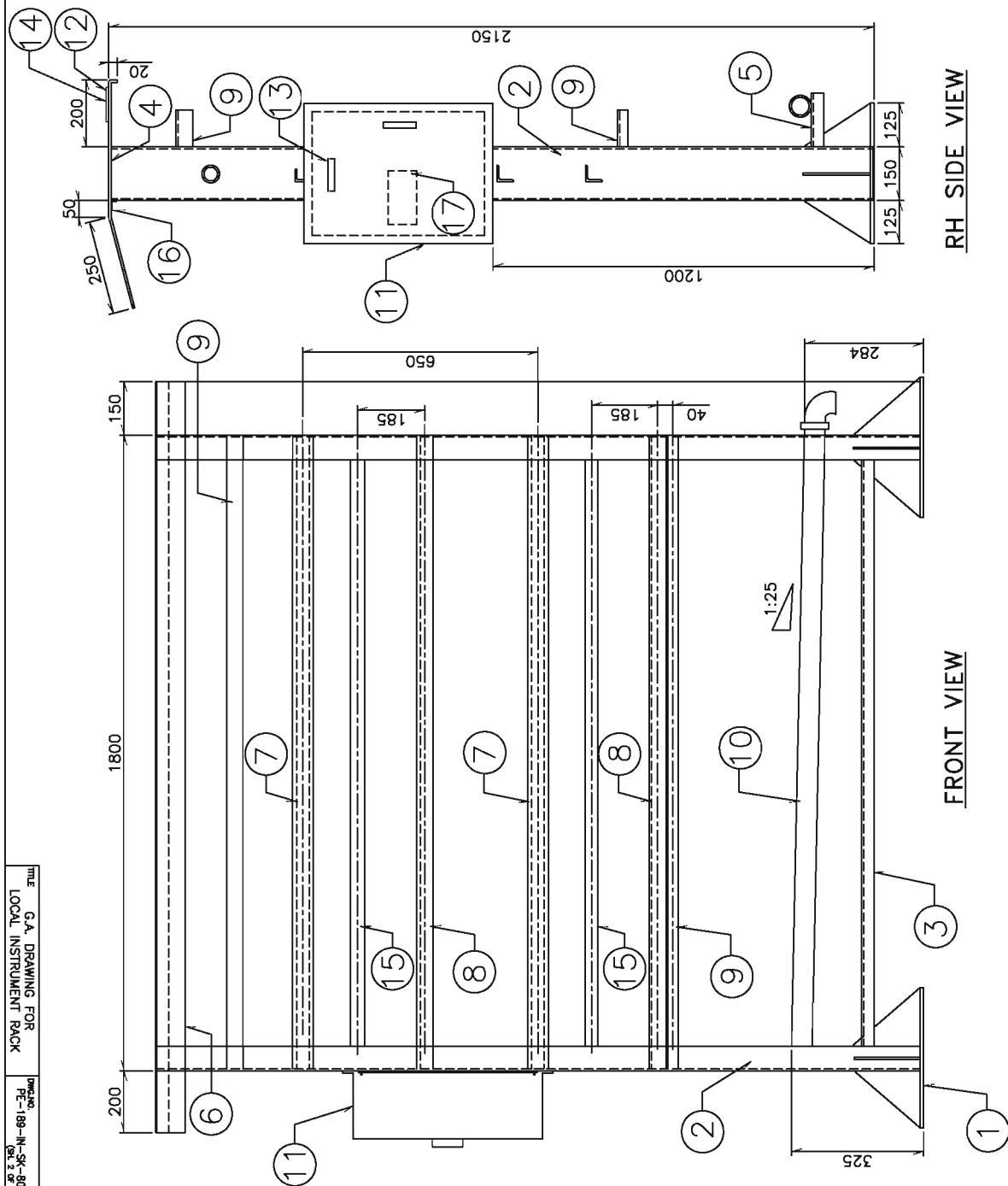
DR P.N.Z.

CH D.J.P.

DWG.NO.PE-189-IN-SK-8004

(SH. 1 OF 10)

PO



LEGEND:

ITEM NO.	DESCRIPTION
1.	M.S. PLATE 400 x 400 x 10
2.	ISMC 150 x 75 x 6
3.	ISMC 75 x 40 x 5
4.	CANOPY MOUNTING PLATE 5mm THICK.
5.	BRACKET FOR DRAIN PIPE.
6.	CANOPY ASSEMBLY 3.0mm THICK CRCA SHEET.
7.	GI PIPE 2" NB CLASS B FOR TRANSMITTER MOUNTING.
8.	M.S. ANGLE 40 x 40 x 5
9.	BRACKET FOR IMPULSE PIPE SUPPORT.
10.	DRAIN PIPE MATERIAL ASTM A106 GR. 'C' SIZE 2" NB SCH 80.
11.	JUNCTION BOX SIZE: 480(H) x 360(W) x 180(D).
12.	BULKHEAD M.S. PLATE 5mm THICK.
13.	COMPACT FLUORESCENT LAMP FOR RACK ILLUMINATION.
14.	XIPE GASKET IN BETWEEN BULKHEAD PLATE & CANOPY MOUNTING PLATE.
15.	PVC CABLE TRAY/ FLEXIBLE CONDUIT FOR CABLE
16.	C' CHANNEL FOR LIGHT FITTING.
17.	TAG PLATE.

NOTES:

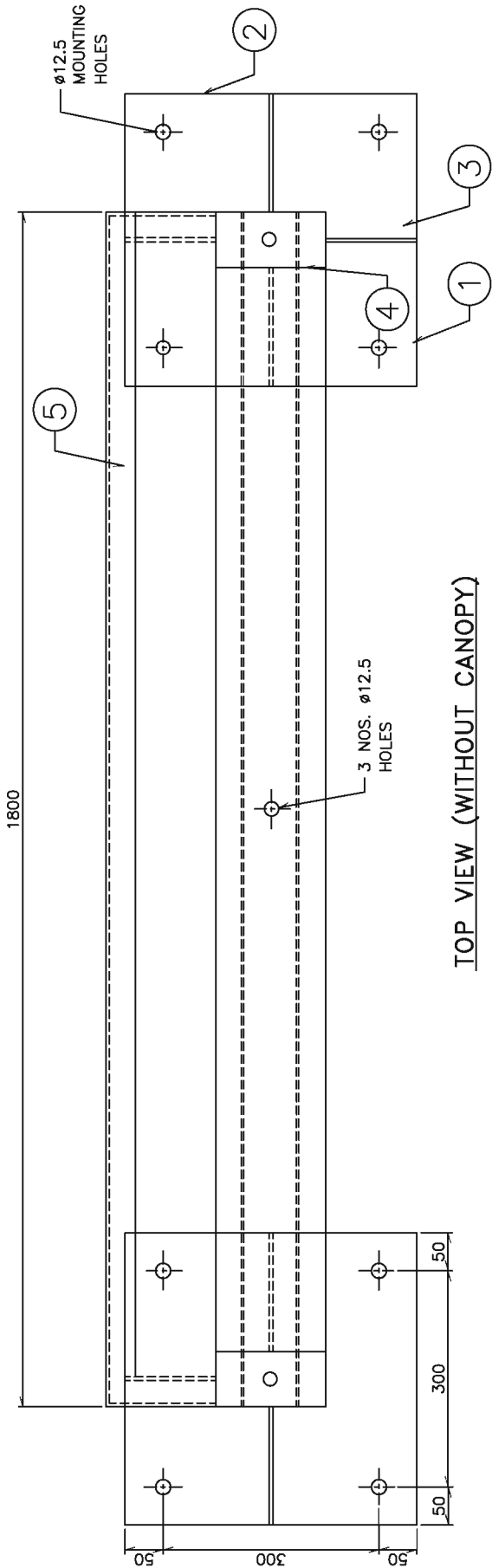
1. POWER SOCKET & TB SHALL BE PROVIDED IN JB.
2. COLOR: RAL 7032. OVERALL THICKNESS > 100 MICRONS.
3. TAG PLATE SHALL BE PROVIDED FOR EACH INSTRUMENT.
4. 20% TERMINALS SHALL BE PROVIDED AS SPARE.
5. ANTIVIBRATION PAD & FOUNDATION BOLTS SHALL BE PROVIDED.
6. DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAILING.
7. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

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PROJECT
PE-189-IN-SK-8004
(S. 3 OF 10)

TITLE
VIEW OF LOCAL
INSTRUMENT RACK W/O CANOPY



- NOTES:**
1. M.S. PLATE 400 x 400 x 10.
 2. RIB M.S. PLATE 162.5 x 170 x 5 THICK.
 3. RIB M.S. PLATE 125 x 170 x 5 THICK.
 4. RIB M.S. PLATE 134 x 165 x 5 THICK.
(CANOPY MOUNTING PLATE SUPPORT)
 5. BRACKET FOR IMPULSE PIPE SUPPORT.
 6. ALL DIMENSIONS ARE IN mm
UNLESS OTHERWISE SPECIFIED.

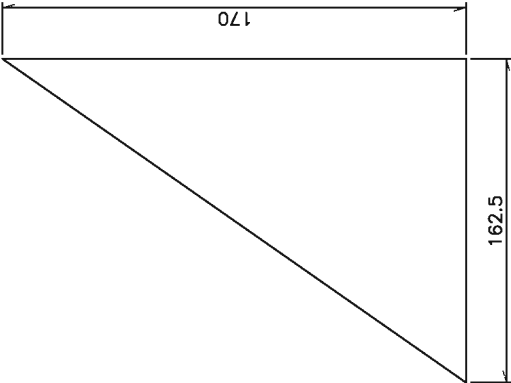
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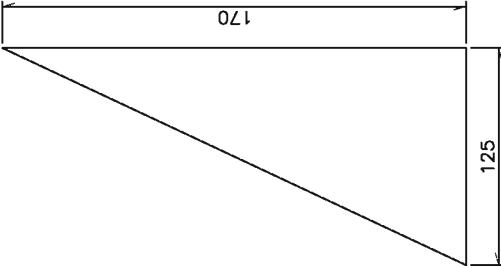
ISSUE	REVISIONS	BY	CHEM	CNIL	ELEC	IBC	MECH	APPD	DATE	FOR RD ISSUE ONLY				FOR PROPOSED WORK NOT TO BE USED FOR CONSTRUCTION UNLESS SPECIFICALLY NOTED OTHERWISE THESE DIMENSIONS ARE NOT TO BE USED FOR CONSTRUCTION UNLESS SPECIFICALLY NOTED OTHERWISE	MAHARASHTRA STATE POWER GENERATION CO. LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT VIEW OF LOCAL INSTRUMENT RACK W/O CANOPY	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.) SCALE ~ DWG. INST. APPROVED DR. P.N.Z. CHK. D.J.P. DATE 23-08-2011 PAGE 1 OF 10 PE-189-IN-SK-8004(S. 3 OF 10) P.0
										CLEARED	SIGNATURE	DATE	DATE			
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TM
G.A. DRAWING OF CLEATS FOR
LOCAL INSTRUMENT RACK

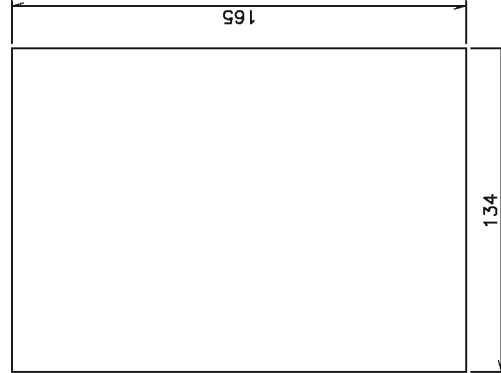
PE-189-IN-SK-8004
(SHEET 1 OF 19)



DETAIL OF-1



DETAIL OF-2

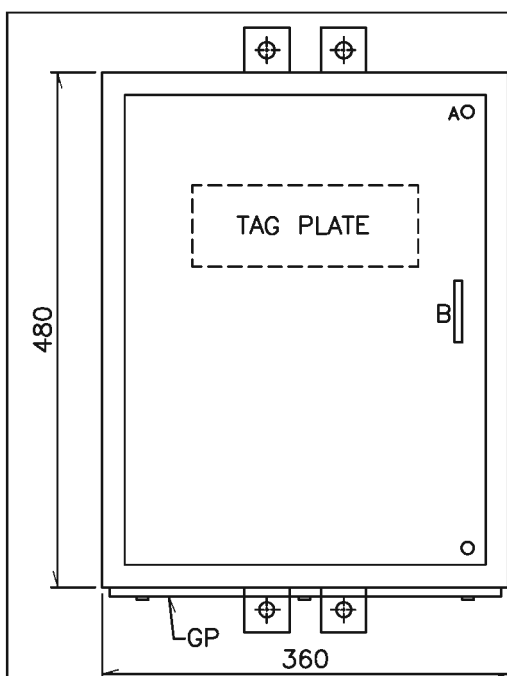
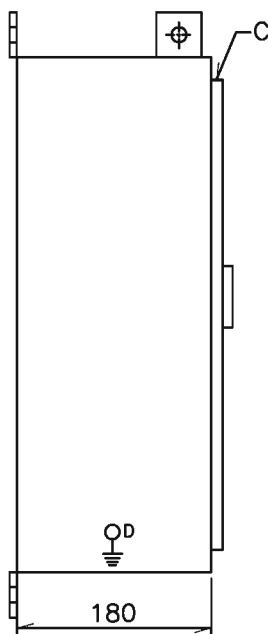
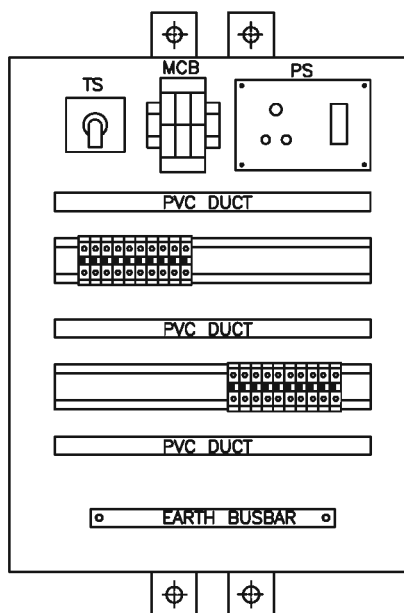


DETAIL OF-3

NOTES:

- 1. RIB M.S. PLATE 162.5 x 170 x 5 THICK.
- 2. RIB M.S. PLATE 125 x 170 x 5 THICK.
- 3. RIB M.S. PLATE 134 x 165 x 5 THICK.
- 4. ALL DIMENSIONS ARE IN mm
UNLESS OTHERWISE SPECIFIED.

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CH. D.J.P.	DWG.NO. PE-189-IN-SK-8004 (SHEET 1 OF 19) PO
MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT MAHENDU	
G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK	
FOR RD ISSUE ONLY	
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FRONT VIEWSIDE VIEWINTERNAL FRONT VIEW**LEGEND:**

- A – DOOR LOCK
 B – DOOR HANDLE
 C – HINGES
 D – EARTH STUD
 GP – GLAND PLATE
 PS – POWER SOCKET
 TS – TOGGLE SWITCH
 TBS – TERMINAL BLOCKS

NOTES:

1. JB WILL BE MADE OUT OF 2.0 mm CRCA SHEET.
2. PROTECTION CLASS IP-65.
3. COLOR: EXT.-RAL 7032, INT.-BRILLIANT WHITE.
4. NUTS FOR MOUNTING THE JUNCTION BOX SHALL BE PROVIDED.
5. 3 mm THICK CRCA GLAND PLATE (GP) AT BOTTOM SHALL BE PROVIDED.
6. SCREWLESS CAGE CLAMP TERMINALS SHALL BE USED.
7. EARTH BUS BAR SHALL BE OF 25x6 TINNED COPPER.
8. INSTRUMENT TAG VIS-A-VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF DOOR.
9. COLOR CODE FOR POWER SUPPLY:
 PHASE-RED, NEUTRAL-BLACK & EARTH – GREEN.
10. CABLE FOR PANEL LIGHTING SHALL BE 1.5 SQ.mm, 1100V GRADE.
11. SIGNAL WIRING SHALL BE 4Px0.5 SQ.mm TINNED COPPER, TWISTED PAIR, OVERALL SHIELDED 500V GRADE, FRLS PVC.
12. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

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CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

G.A. OF JB LOCAL INSTRUMENT RACK

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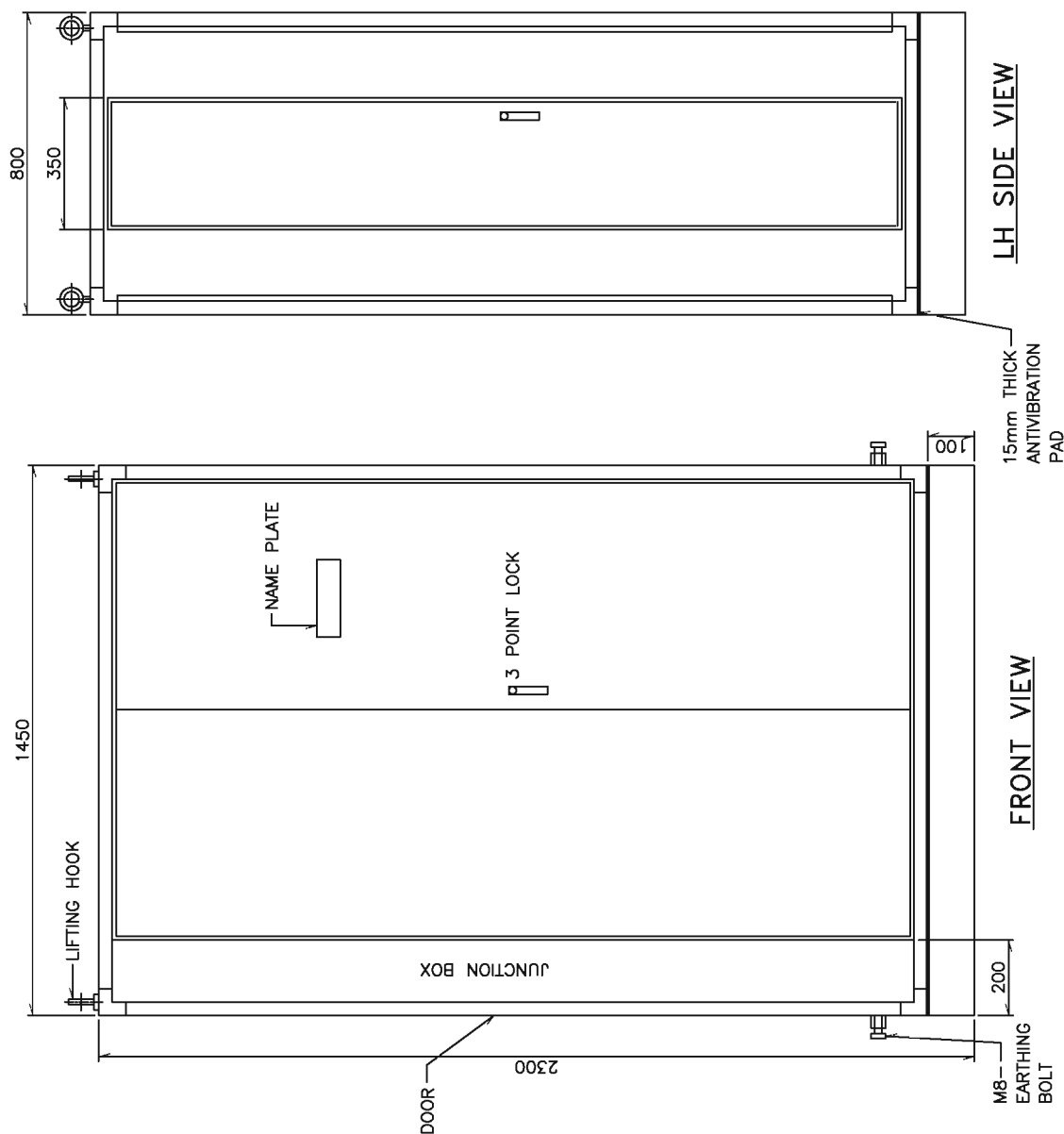
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DWG.NO.PE-189-IN-SK-8004

SHEET 5 OF 10

PO

LOCAL INSTRUMENT ENCLOSURE



NOTES:

1. DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAILING.
2. ALL SHEETS SHALL BE 3mm THICK CRCA SHEET.
3. ALL DOORS SHALL BE FLUSH/CONCEALED TYPE.
4. COLOR:
EXTERIOR : RAL 7032.
INTERIOR : BRILLIANT WHITE OVER ALL THICKNESS WILL BE > 100 MICRONS.
5. BASE FRAME WILL BE MADE OUT OF ISMC 100 AND COLOR WILL BE BLACK PAINT FINISH.
6. BULKHEAD PLATE FOR TOP AND BOTTOM SHALL BE 1150 x 650 x 6.
7. CABLE GLAND PLATE OF THICKNESS 3mm CRCA SHEET SHALL BE PROVIDED BOTTOM OF JUNCTION BOX.
8. ENCLOSURE PROTECTION CLASS SHALL IP-65.
9. TERMINALS INSIDE JUNCTION BOX SHALL BE SCREWLESS CAGE CLAMP TYPE.
10. DOORS SHALL BE PROVIDED WITH CONCEALED HINGES, THREE POINT LOCKING FOR FRONT, REAR AND SIDE DOOR HINGES SHALL BE OF STAINLESS STEEL.
11. XLPE GASKET SHALL BE PROVIDED BETWEEN BULKHEAD PLATE & ENCLOSURE.
12. EARTH BUSBAR 25 x 6 TINNED COPPER.
13. DRAIN PIPE SLOPE SHALL BE 1:25 APPROX.
14. COMMON LOCK/KEY SHALL BE PROVIDED FOR ALL LIE'S & JB'S.
15. FOUNDATION BOLTS SHALL BE PROVIDED.
16. TAG PLATES SHALL BE PROVIDED FOR EACH INSTRUMENTS.
17. INSTRUMENT TAG VIS-A-VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF JUNCTION BOX DOOR.
18. 20% TERMINALS SHALL BE PROVIDED AS SPARE.
19. NAME PLATE OF PANEL SHALL BE FIXED ON FRONT DOOR.
20. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

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DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

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MAHARASHTRA STATE POWER GENERATION CO.LTD.

BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

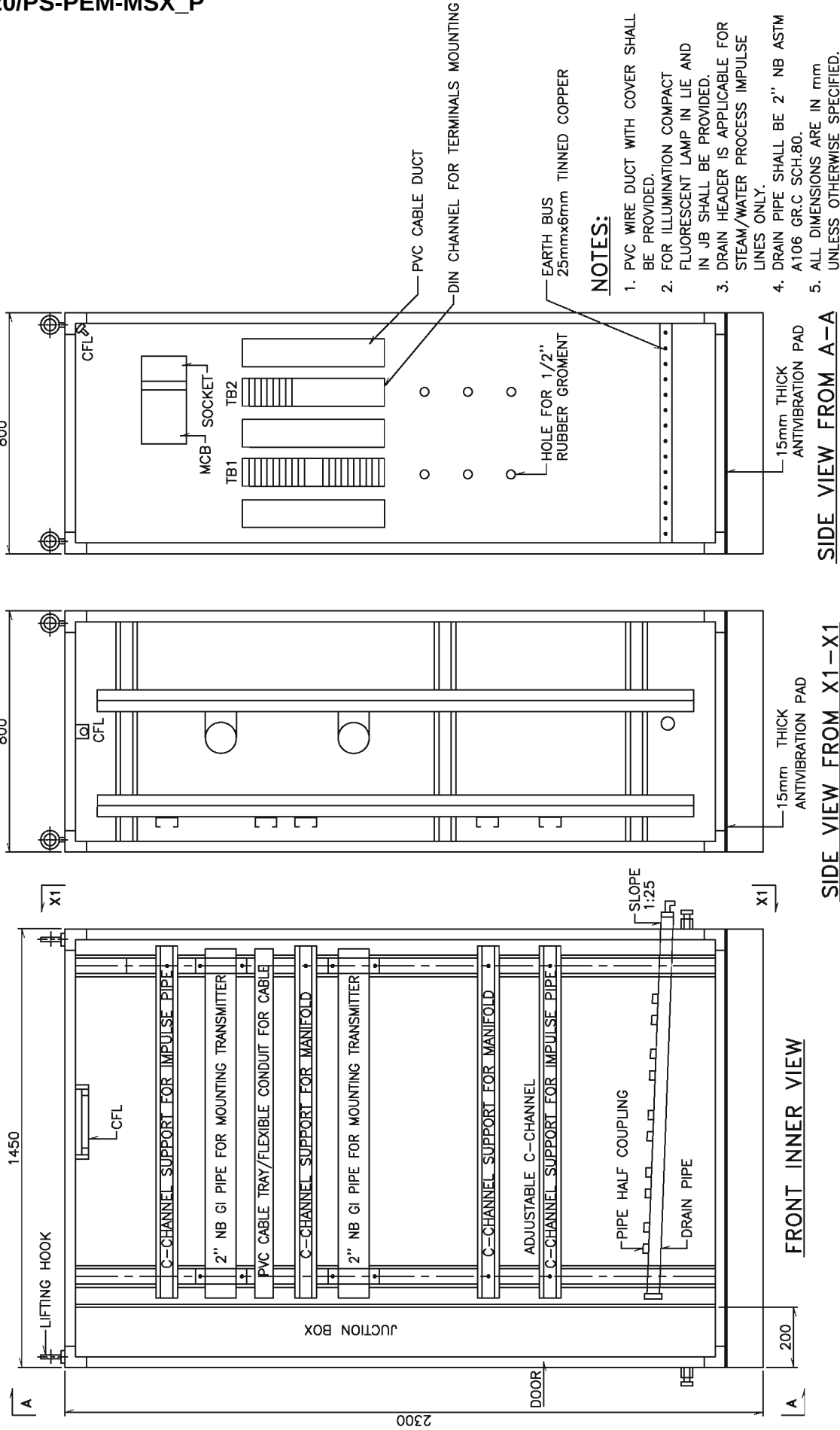
GA DRAWING FOR

LOCAL INSTRUMENT ENCLOSURE

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INNER G.A. DRAWING FOR
LOCAL INSTRUMENT ENCLOSURE

PE-189-IN-SK-8004
(REV. 7 OF 10)



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MECH				DR. P.N.Z.			
DATE				DWG. NO.			
Cleared				PE-189-IN-SK-8004 (Rev. 7 of 10)			
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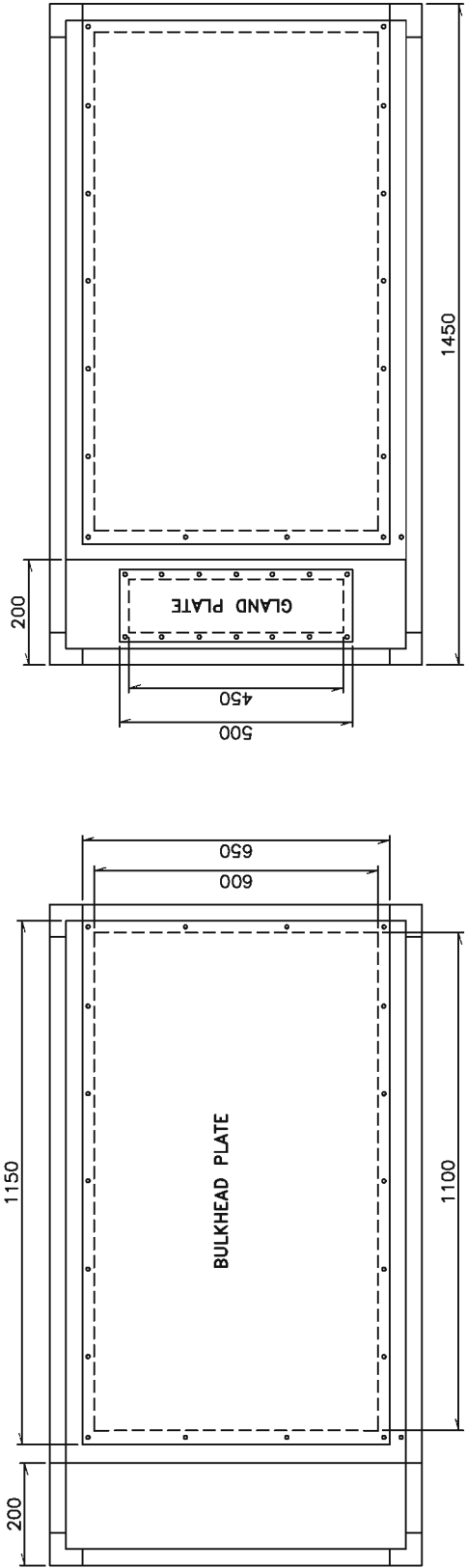
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Rev. 8 of 19

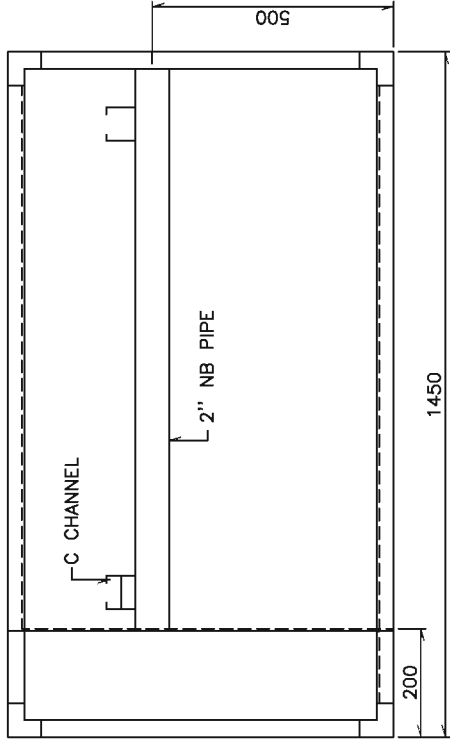
LOCAL INSTRUMENTS ENCLOSURE

MAHARASHTRA STATE POWER GENERATION CO. LTD.



TOP VIEW

BOTTOM VIEW



TOP VIEW WITHOUT BULKHEAD PLATE

NOTES:

1. BULK HEAD PLATE DIMENSION ARE 1150 x 650 x 6.
2. IMPULSE PIPE ENTRY: BOTTOM ENTRY FOR AIR/FLUE GAS APPLICATIONS.
3. IMPULSE ENTRY: TOP ENTRY FOR STEAM/WATER APPLICATIONS.
4. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

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DATE (RO ISSUE)

DR. INST.

DATE (BID ISSUE)

DR. P.N.Z.

23-08-2011

DR. D.J.P.

DWG.NO. PE-189-IN-SK-8004 (Rev. 8 of 19)

P.O.

MAHARASHTRA STATE POWER GENERATION CO. LTD.

BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

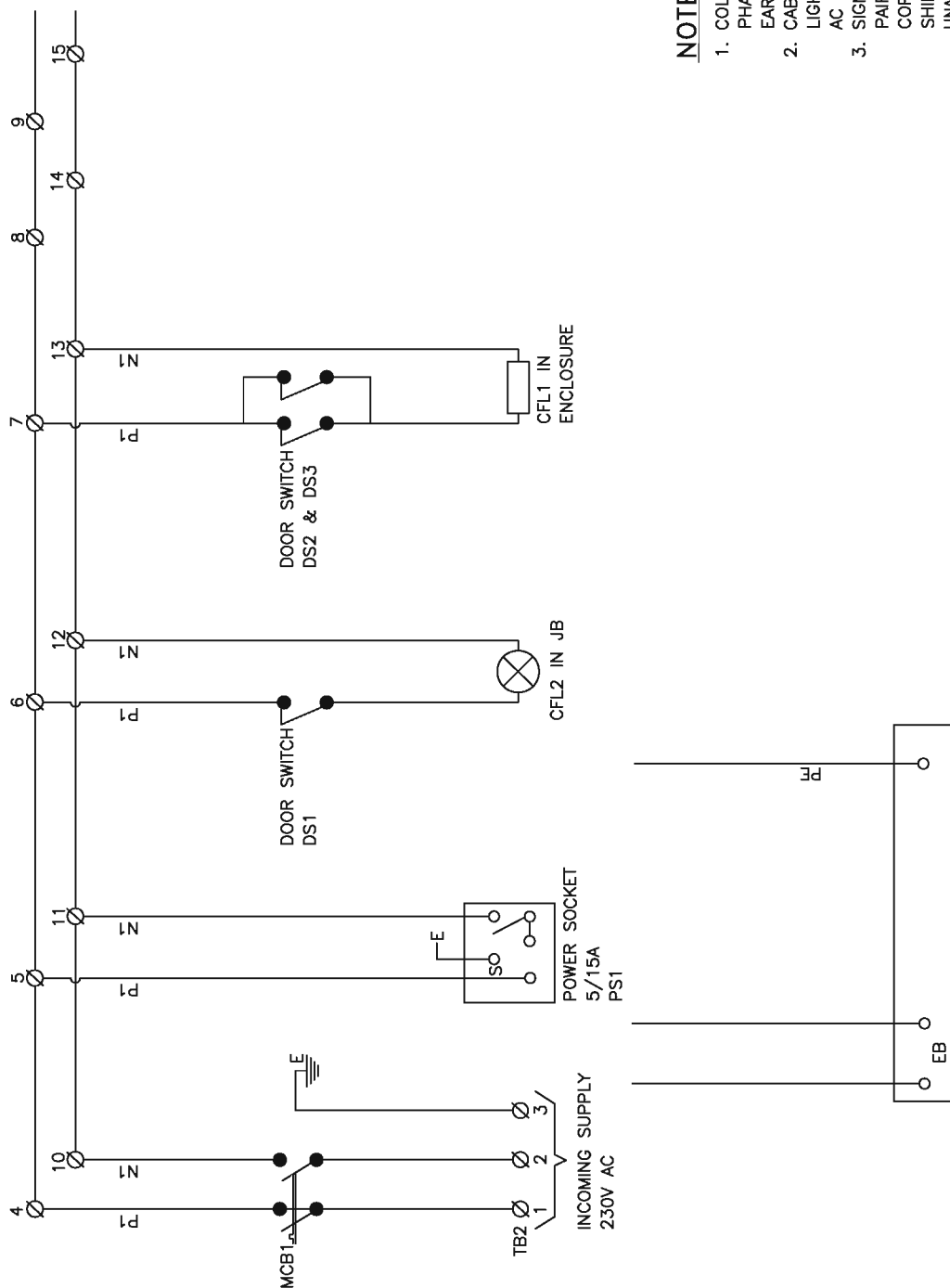
BULKHEAD DETAILS FOR

LOCAL INSTRUMENT ENCLOSURE

THIS DRAWING IS THE PROPERTY OF THE COMPANY AND IS NOT TO BE REPRODUCED OR COPIED IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF THE COMPANY. THE COMPANY ACCEPTS NO RESPONSIBILITY FOR ANY LOSS OR DAMAGE TO THE DRAWING OR FOR ANY INACCURACIES THEREIN. THE USER OF THIS DRAWING SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPROPRIATE AUTHORITIES. THE COMPANY SHALL NOT BE LIABLE FOR ANY CONSEQUENCES ARISING FROM THE USE OF THIS DRAWING. THE COMPANY SHALL NOT BE RESPONSIBLE FOR ANY DELAYS OR OMISSIONS IN THE WORK DUE TO UNREASONABLE INSTRUCTIONS OR CHANGES IN THE WORK ORDERED BY THE USER. THE COMPANY SHALL NOT BE RESPONSIBLE FOR ANY INJURY OR DAMAGE TO PERSONS OR PROPERTY ARISING FROM THE USE OF THIS DRAWING. THE COMPANY SHALL NOT BE RESPONSIBLE FOR ANY LOSS OF PROFITS OR BUSINESS ARISING FROM THE USE OF THIS DRAWING. THE COMPANY SHALL NOT BE RESPONSIBLE FOR ANY OTHER CONSEQUENCES ARISING FROM THE USE OF THIS DRAWING.

ISSUE	REVISIONS	BY	CLEARED				APPD	DATE	FOR RO ISSUE ONLY			
			CHEM	CIVIL	ELEC	MECH			DEPT	SIGNATURE	DATE	

POWER WIRING CIRCUIT

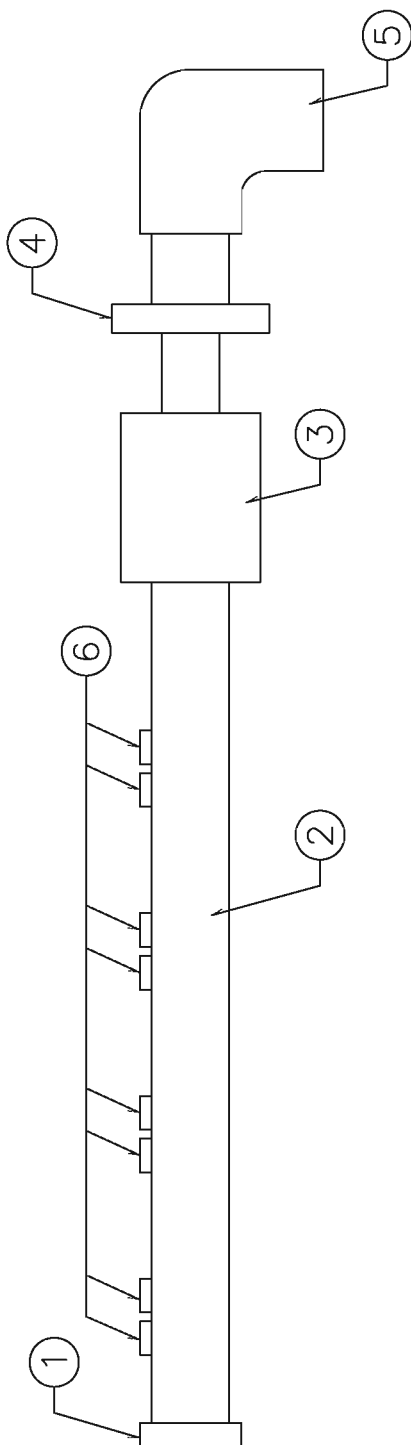


NOTES:

1. COLOR CODING FOR POWER SUPPLY:
PHASE-RED, NEUTRAL-BLACK AND
EARTH-GREEN.
2. CABLE ROUTING FROM TB TO PANEL
LIGHT WILL BE 1.5 sq.mm 1100V
AC GRADE.
3. SIGNAL WIRING WILL BE DONE BY 4
PAIR x 0.5 sq.mm ANNEALED TINNED
COPPER, PAIR TWISTED OVERALL &
SHIELDED, VOLTAGE GRADE 1100V,
UNARMoured FRLS PVC SHIELDED CABLE.

FOR BID PURPOSE ONLY

[illegible]



BILL OF MATERIAL		
S/L. NO.	DESCRIPTION	QTY.
1	2" S.W. CAP, CS	1
2	2" NB, ASTM A-106, SCH 80/GR. C	1
3	2" SW x 1" NPT(F) COUPLING, CS	1
4	1" NPT(M) x 1" BSP(M) HEX. NIPPLE WITH FITTING, CS	1
5	1" BSP(F) ELBOW, CS (BOTH ENDS THREADED)	1
6	HALF COUPLING; SIZE; 1/2" NB SW	AS REQD.

FOR BID PURPOSE ONLY

[illegible]

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

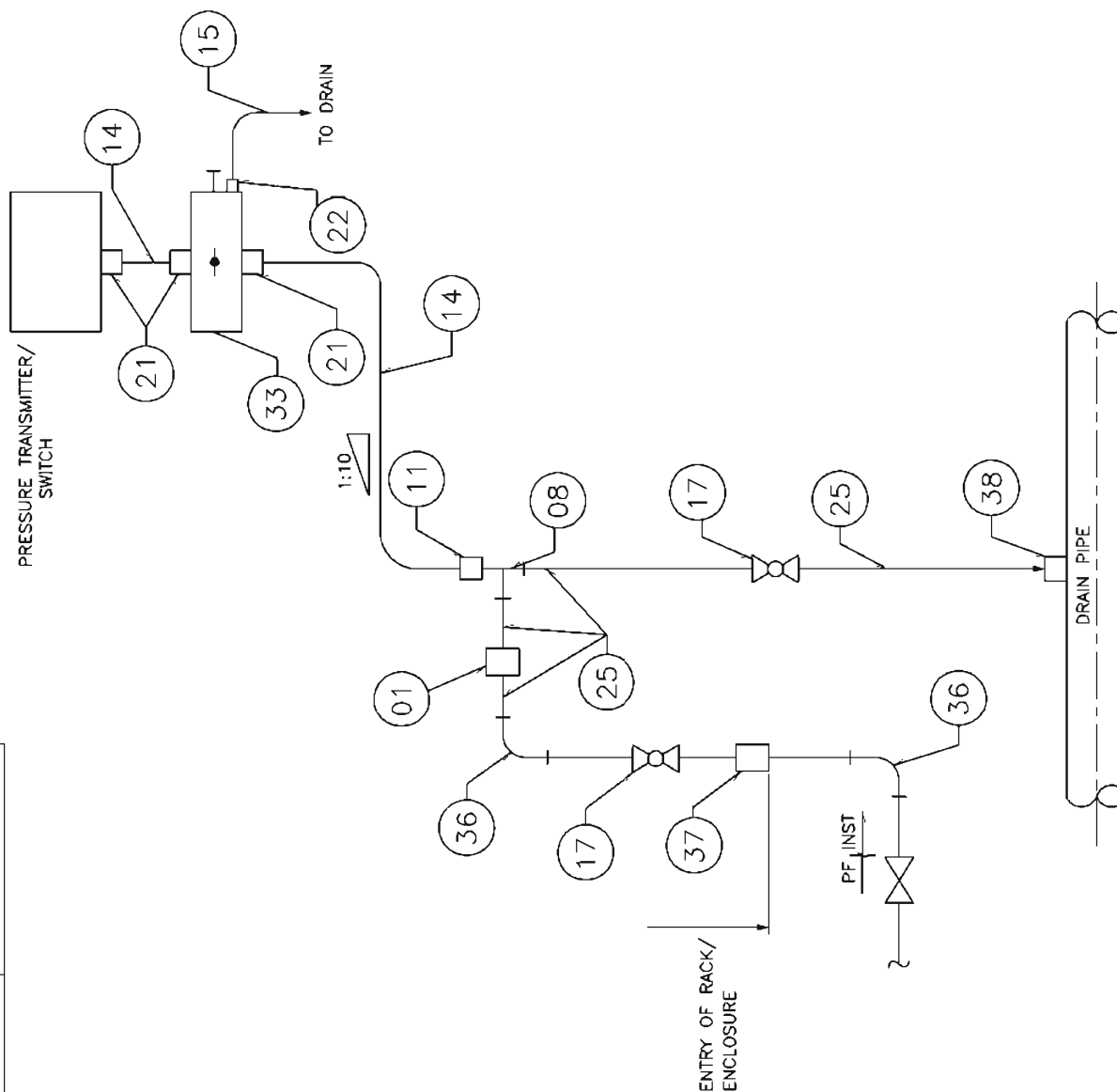
				FOR BID PURPOSE ONLY	
				DO NOT SCALE	DATE : 23-08-2011
ISSUE	BY	CH	DATE	TYPICAL INSTRUMENT INSTALLATION DIAGRAM	
				PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)	
				CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD. PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	
				SCALE ~	APPROVED
				DIV INST.	
				DR P.N.Z.	
				CH D.J.P.	DWG.NO.PE-189-IN-SK-8003 (SH. 1 of 20) PD

NOTES:

1. PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/ TEMPERATURE REQUIREMENT. FOR LINE PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ. CM. 2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.
2. MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY. ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION AND SPECIFICATION OF CONTROL & INSTRUMENTATION.
3. DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB SCH 80.

				FOR BID PURPOSE ONLY	
				DO NOT SCALE	DATE : 23-08-2011
ISSUE	BY	CH	DATE	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)	
				CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD. PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	
				SCALE ~	APPROVED
				DIV INST.	
				DR P.N.Z.	
				CH D.J.P.	DWG.NO. PE-189-IN-SK-8003 (Sht. 2 of 20) PD

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED ABOVE SOURCE POINT



SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

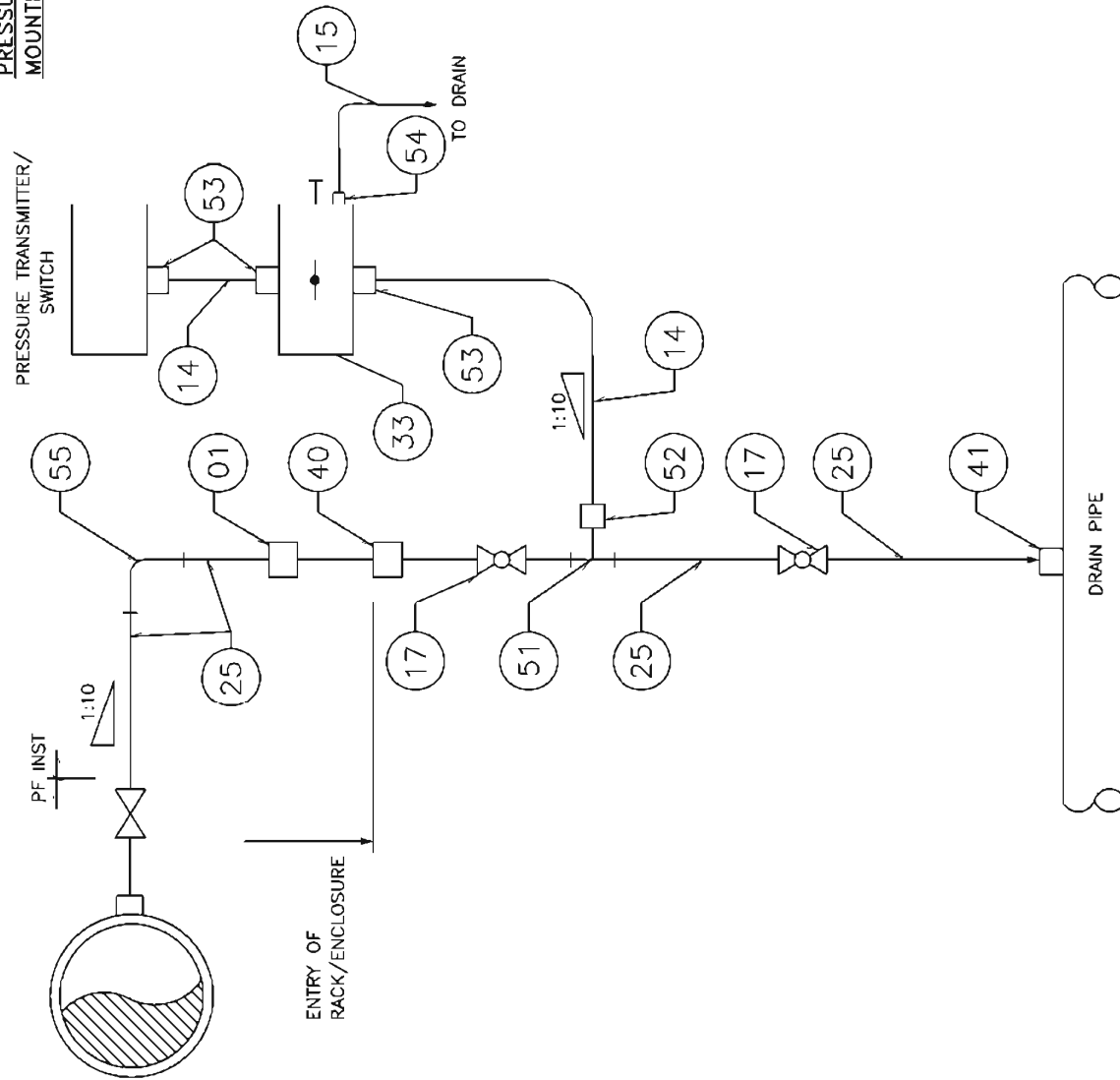
BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
08	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs, CS/AS
11	1	MALE CONNECTOR 1/2" PE x 1/2" OD 3000 lbs OF CS/AS
17	2	GLOBE VALVE 1/2" SW 800lbs OF CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2.1mm THICK, SS 316
21	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 3000 lbs, SS 316
25	15 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
33	1	2 VALVES MANIFOLD 1/2" NPT(F). SS 316
01	1	FULL COUPLING 1/2" SW 3000lbs, CS/AS
15	0.15 MTRS.	TUBE 8mm OD, 1.0mm THK. SS 316
22	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD 3000 lbs
36	2	90° ELBOW 1/2" SW 3000lbs, CS/AS
37	1	BULKHEAD UNION/COUPLING CL:3000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS
38	1	HALF COUPLING CL:3000 lbs/ 1/2" NB-SW, AS PER ANSI B16.11, CS/AS

FOR BID PURPOSE ONLY

[illegible]

4434/2020/PS-PEM-MSX_P

**PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT**



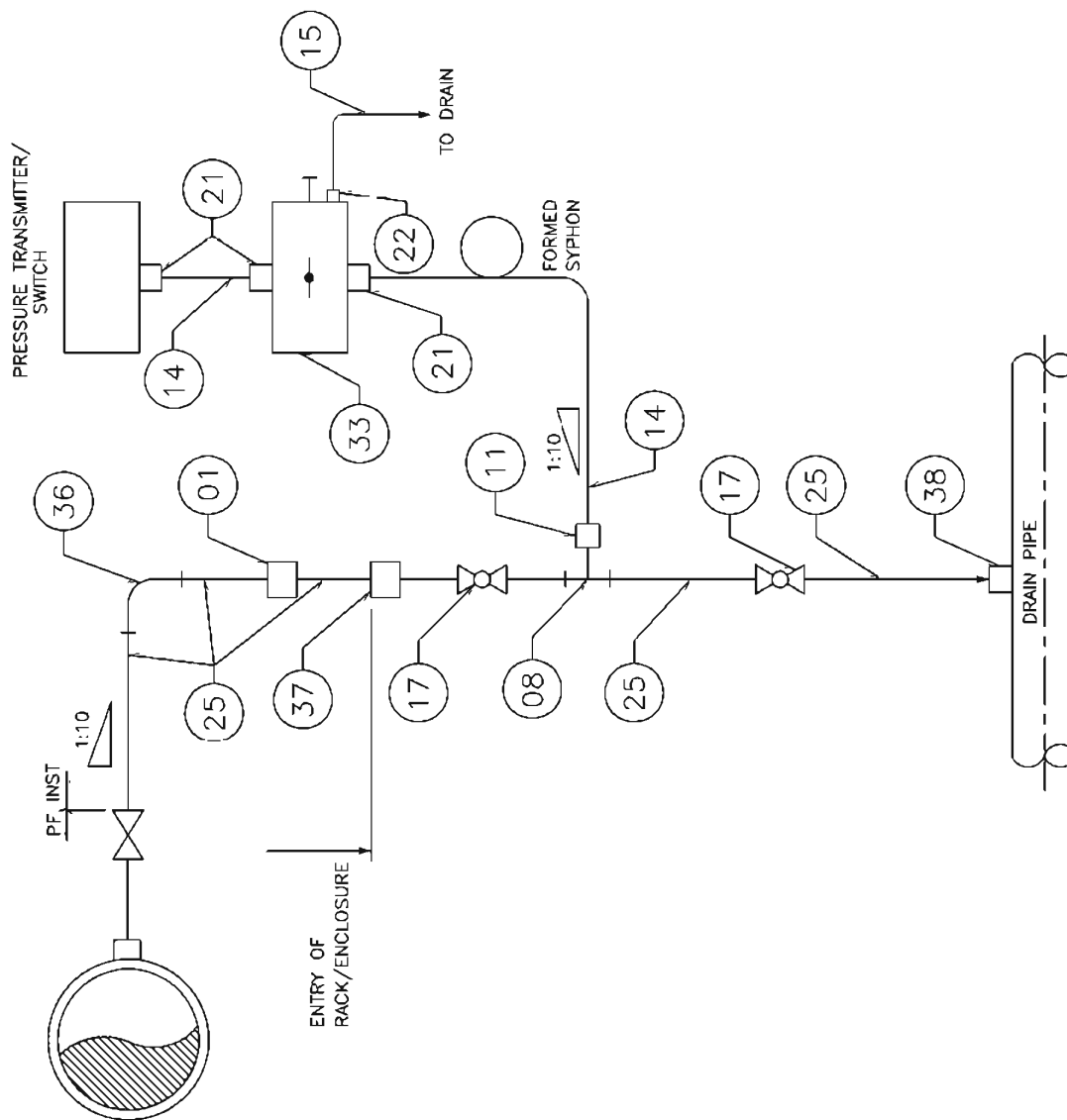
BILL OF MATERIAL		
ITEM NO.	QTY./INST.	DESCRIPTION
51	1	EQUAL TEE (FEMALE) 1/2" SW 6000lbs, CS/AS
52	1	MALE CONNECTOR 1/2" PE x 1/2" OD 6000 lbs, CS/AS
17	2	GLOBE VALVES 1/2" SW 800lbs, CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2.1mm THK, SS 316
53	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 6000 lbs, SS 316
25	15 MTRS.	IMPULSE PIPE 15 NB GR.B SCH 80, CS/AS
33	1	2 VALVES MANIFOLD 1/2" NPT(F), SS 316
01	1	FULL COUPLING 1/2" SW 6000lbs, CS/AS
15	0.15 MTRS.	TUBE 8mm OD, 1.0mm THK, SS 316
54	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD 6000 lbs, SS 316
55	2	90° ELBOW 1/2" SW 6000lbs, CS/AS
40	1	BULKHEAD UNION/COUPLING CL:6000 lbs, 1/2"NB-SW, AS PER ANSI B16.11, CS/AS
41	1	HALF COUPLING CL:6000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS

SERVICE : CONDENSATE, FEED WATER ETC.

FOR BID PURPOSE ONLY

PROCON ENGINEERS (DIVISION OF MINDO CONSULTING ENGINEERS PVT.LTD.)		MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	
SCALE ~	APPROVED	DATE (FOR ISSUE)	
BY: INST.		DATE (FOR ISSUE)	
CHK. P.N.Z.		DATE (FOR ISSUE)	
ENR. D.J.P.		DATE (FOR ISSUE)	
TYPICAL INSTRUMENT INSTALLATION DIAGRAM		TYPICAL INSTRUMENT INSTALLATION DIAGRAM	

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT (WITH SYPHON)

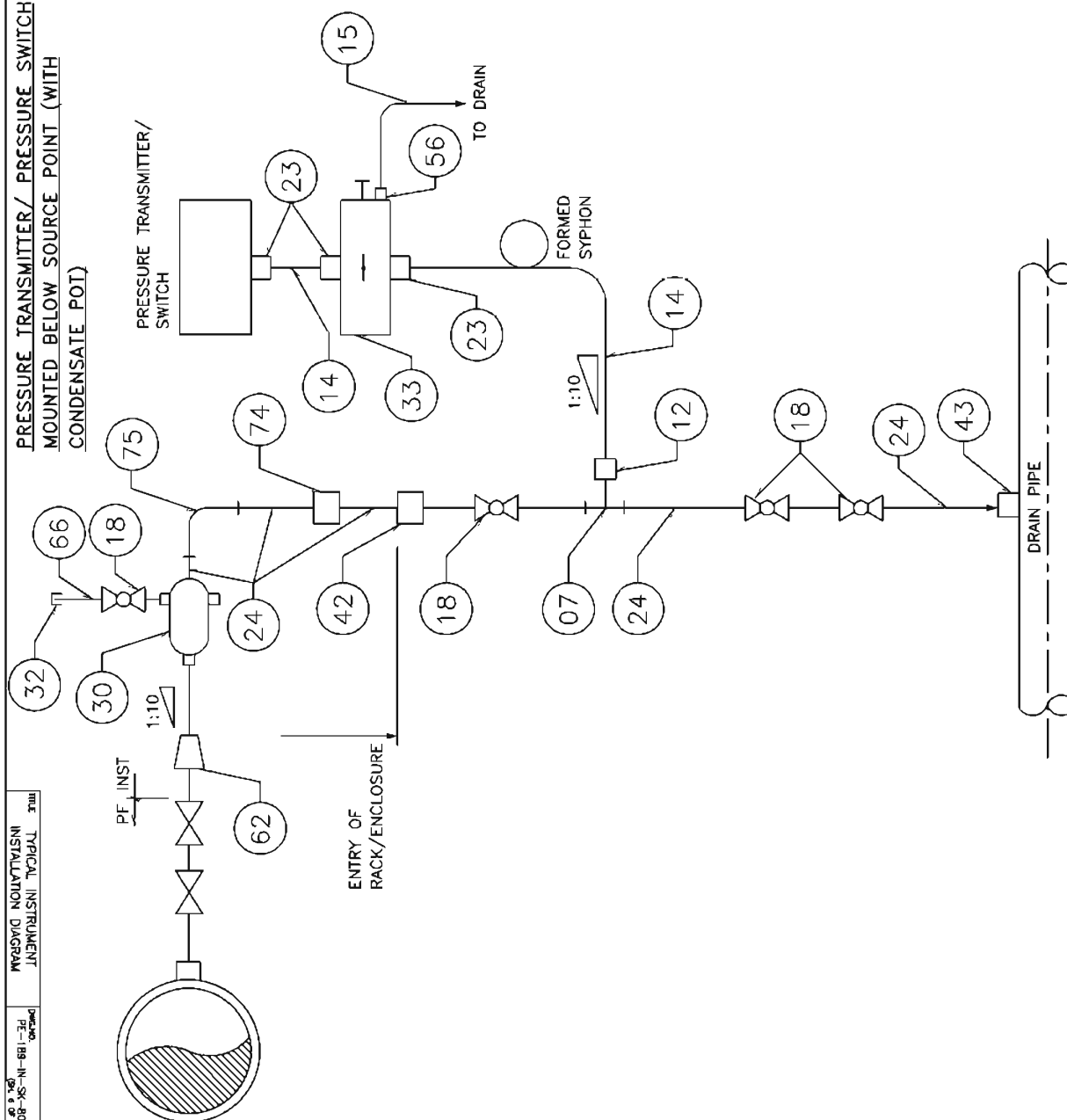


SERVICE : LOW PRESSURE STEAM.

FOR BID PURPOSE ONLY

[illegible]

PRESSURE TRANSMITTER/ PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT (WITH
CONDENSATE POT)

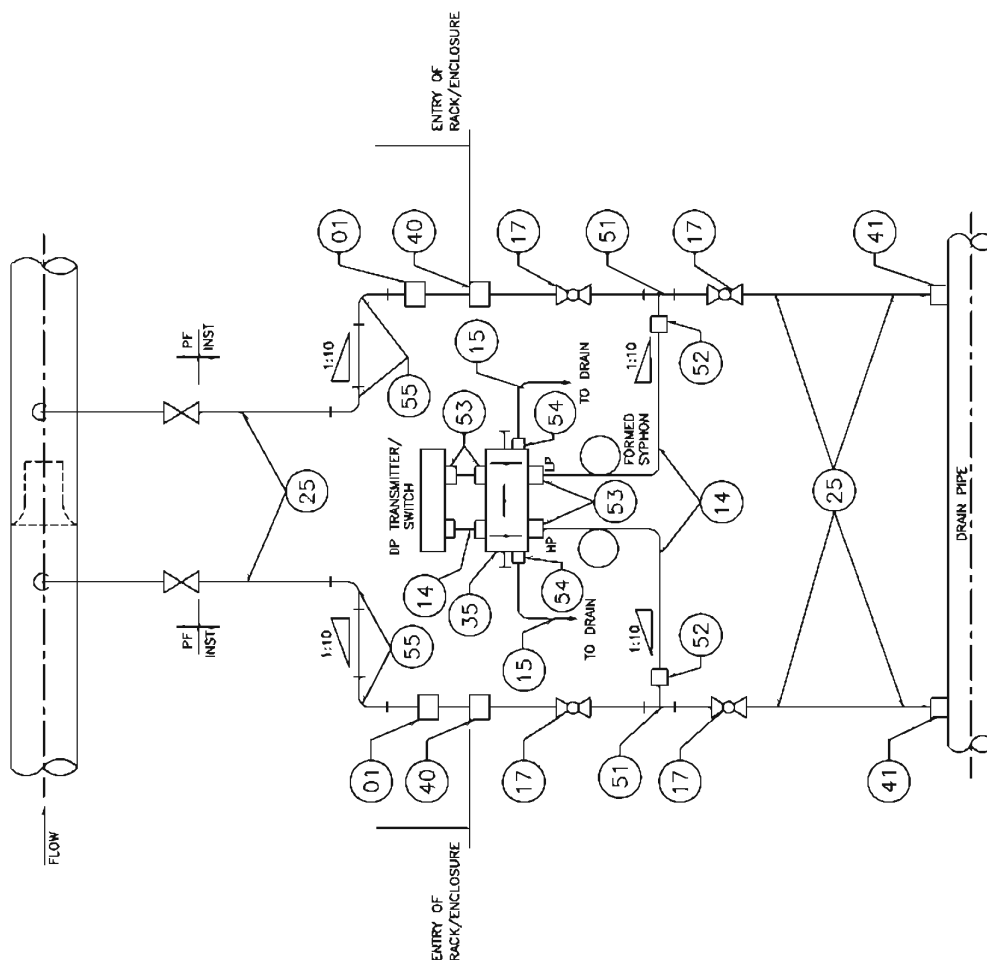


BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
62	1	REDUCER 1"SW x 1/2" SW 9000lbs, CS/AS
07	1	EQUAL TEE (FEMALE)1/2" SW 9000 lbs, CS/AS
12	1	MALE CONNECTOR 1/2" PE x 1/2" OD 9000 lbs, CS/AS
18	4	GLOBE VALVES 1/2" SW 1500 lbs, CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2.mm THK, SS 316
23	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 9000 lbS, SS 316
24	15 MTRS.	IMPULSE PIPE 15 NB SCH. 80, CS/AS
33	1	2 VALVES MANIFOLD 1/2" NPT(F), SS 316
74	1	FULL COUPLING 1/2" SW 9000lbs, CS/AS
15	0.15 MTRS.	TUBE 8mm OD, 1.0mm THK, SS 316
56	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD, 9000 lbs, SS 316
42	1	BULKHEAD UNION/COUPLING CL:9000 lbs- AS PER ANSI B16.11, 1/2" NB-SW, CS/AS
43	1	HALF COUPLING CL:9000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS
75	1	90° ELBOW 1/2" SW CL:9000 lbs, CS/AS
32	1	PLUG 1/2" NPT(F) 9000lbs, CS/AS
30	1	CONDENSATE POT 1/2" SW NPT(F) 9000lbs, CS/AS
66	1	15 NB SCH 80, SW x 1/2" NPT(M), SEAMLESS NIPPLE 6000 lbs, CS/AS

SERVICE : MEDIUM AND HIGH PRESSURE STEAM

FOR BID PURPOSE ONLY

[illegible]



SERVICE : CONDENSATE, FEED WATER ETC.
PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE.

FOR BID PURPOSE ONLY

MAHARASHTRA STATE POWER GENERATION CO. LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT
DO NOT SCALE

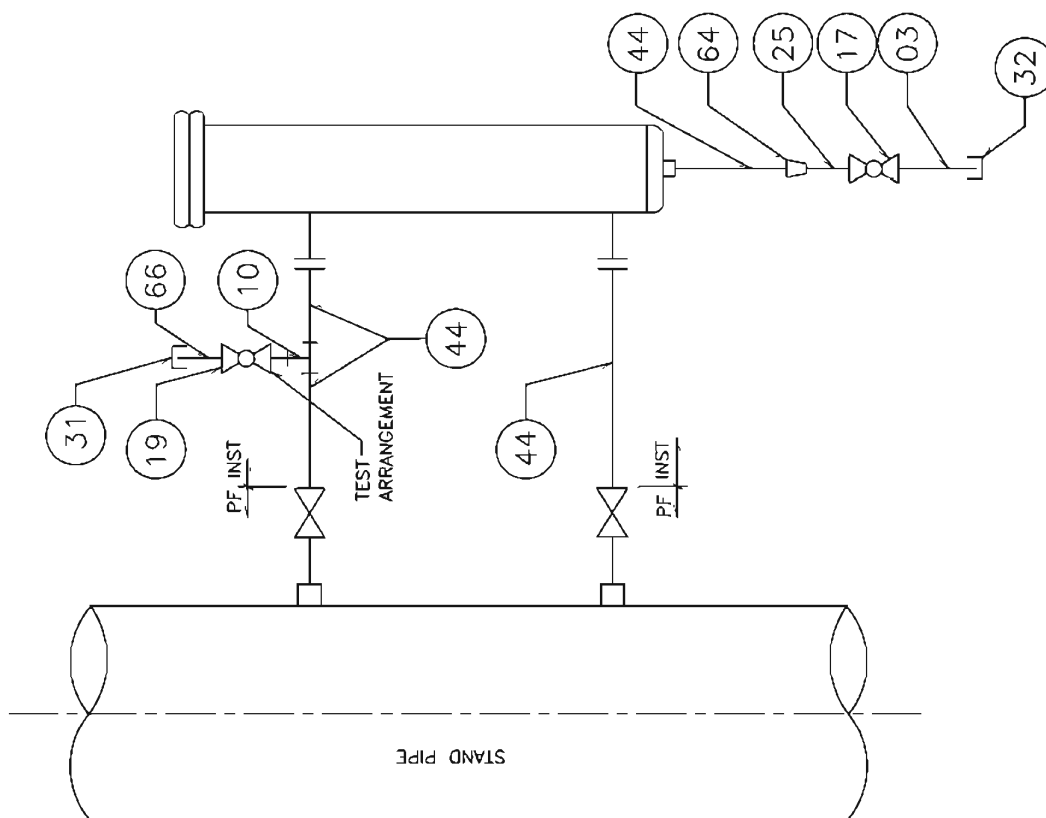
TYPICAL INSTRUMENT
INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

SCALE	~			DATE (NO ISSUE)
DW.	INST.	APPROVED		DATE (CLASSION ISSP)
DL	P.N.Z.			23-08-2011
CH	D.W.P.	DWG. NO. PE-189-N-SK-6003		ISSUE
				P0

ISSUE	REVISIONS	BY	CLEARED				APPD	DATE	FOR RO ISSUE ONLY				
			CHEM	CIVIL	ELEC	I&C			CLEARED		DEPT	SIGNATURE	DATE
✓ FOR SECURITY REASONS, ALL INFO FOR CONSTRUCTION / MAINTENANCE OF THE FACILITY MUST BE OBTAINED FROM THE RO. REQUESTS FOR INFO SHOULD BE LIMITED TO ADDRESS ONE OF THE FOLLOWING: 1. IDENTIFICATION OF THE RIGHT-HALO COVER OF THE TITLE BLOCK 2. IDENTIFICATION OF THE FACILITY PERMITTED ON A RELEASED SUBJECT ONLY 3. IDENTIFICATION OF THE INFORMATION CONTAINED WITHIN A FIELD UNIT OR PERSONNEL FIELD UNIT FOR PERSONNEL OFFICE TO CLEAN UP 4. IDENTIFICATION OF ANY CONTRIBUTION TO / HARBORING OF / INFORMATION RELATED TO THE FACILITY 5. IDENTIFICATION OF PERSONNEL SEPARATED TO MAINTAIN AUTHORIZED REPRESENTATIVE ONLY 6. IDENTIFICATION OF PERSONS EMPLOYED BY THE FACILITY													

FLOAT OPERATED LEVEL SWITCH

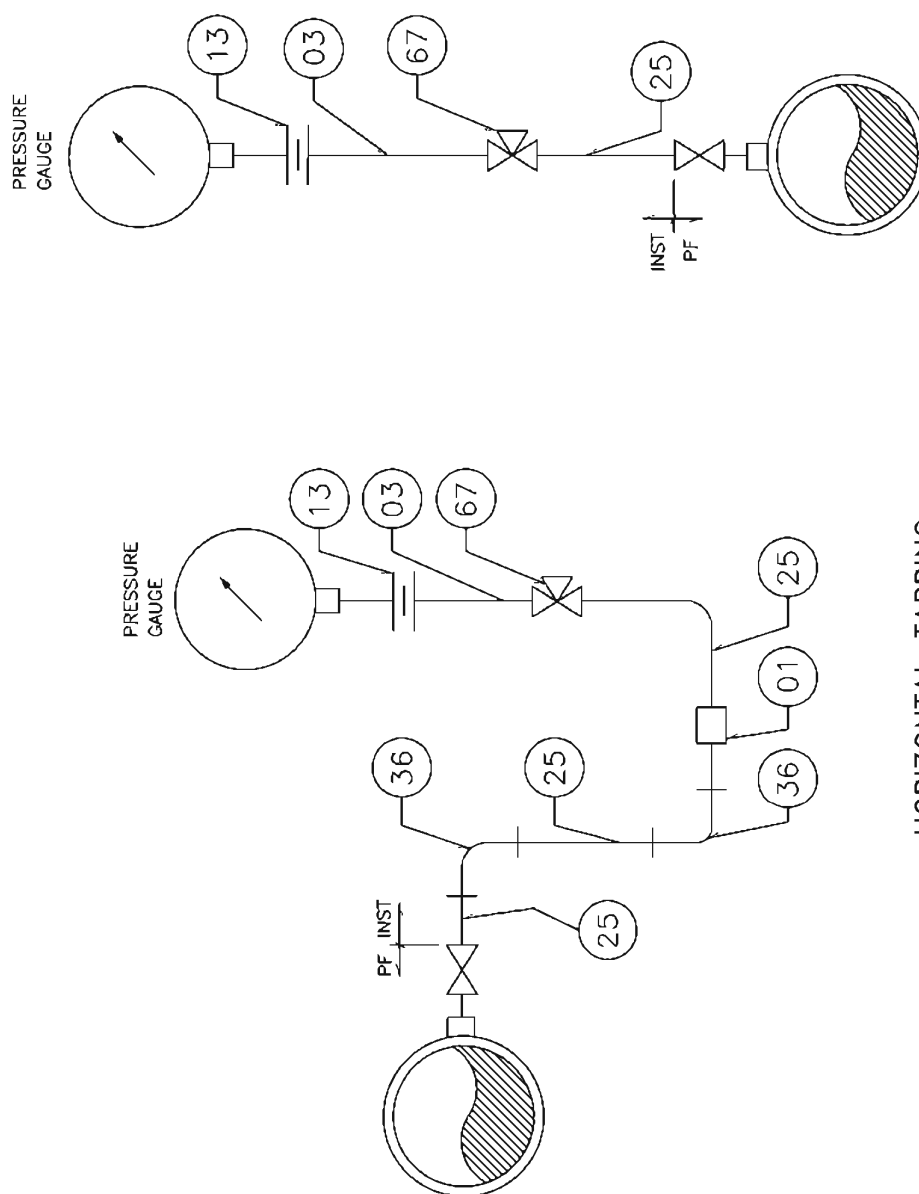


BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
17	1	GLOBE VALVES 1/2" SW 800lbs, CS/AS
25	0.5 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
32	1	PLUG 1/2" NPT(M) 3000lbs, CS/AS
10	2	EQUAL TEE (FEMALE) 1" SW 3000lbs, CS/AS
44	2 MTRS.	IMPULSE PIPE 25 NB SCH 80, CS/AS
64	1	REDUCER 1" SW x 1/2" SW 3000lbs, CS/AS
19	1	GLOBE VALVES 1" SW 800lbs, CS/AS
31	1	PLUG 1" NPT(F) 3000lbs, CS/AS
66	1	1" NB SCH 80 SW x 1" NPT(M) SEAMLESS NIPPLE 3000 lbs, CS/AS
03	1	15 NB SCH 80 SW x 1/2" NPT(M) SEAMLESS NIPPLE 3000lbs, CS/AS

SERVICE : CONDENSATE.

FOR BID PURPOSE ONLY

[illegible]



HORIZONTAL TAPPING

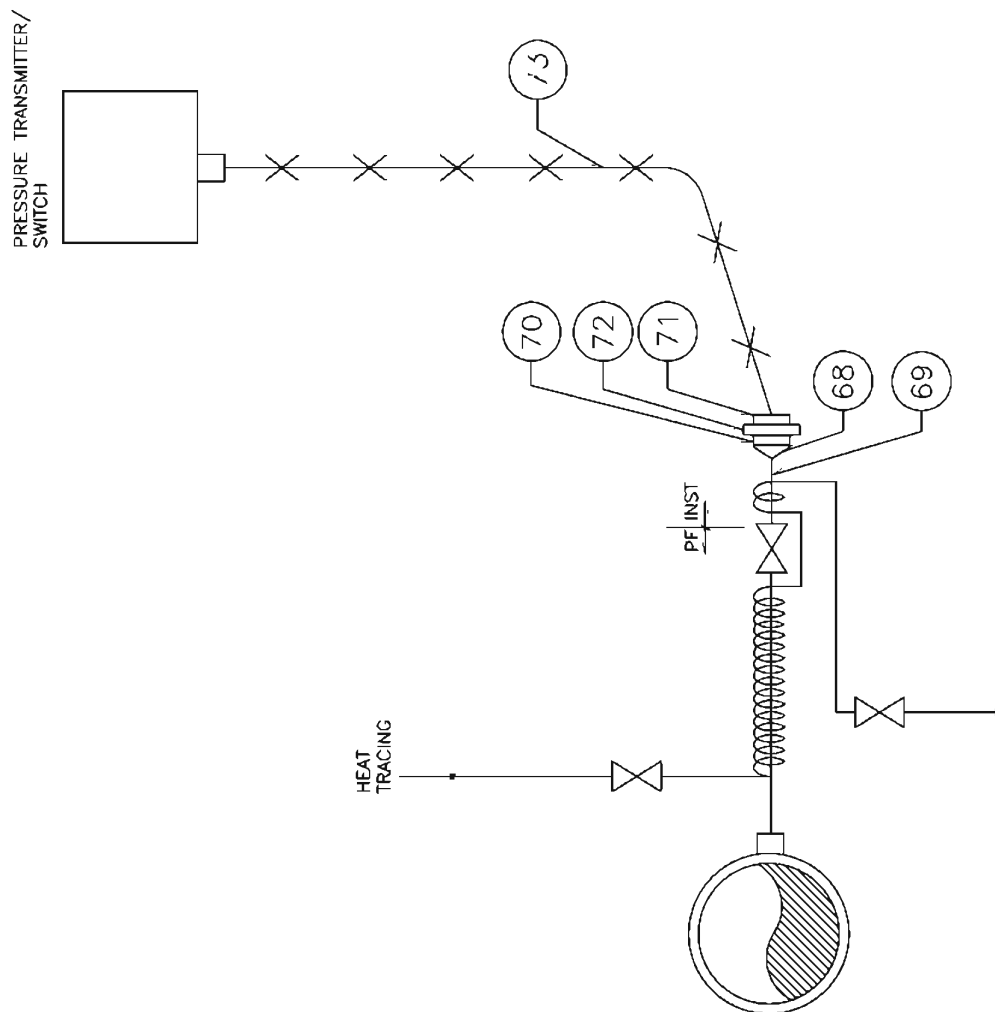
VERTICAL TAPPING

BILL OF MATERIAL			
ITEM NO.	QTY./INST	DESCRIPTION	
25	15 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS	
01	1	FULL COUPLING 1/2" SW 3000lbs, CS/AS	
36	2	90° ELBOW 1/2" SW 3000lbs, CS/AS	
03	1	1/2" NPT(M) x 1/2" PE, 4" LONG NIPPLE, CS/AS	
13	1	NUT & TAIL FITTING WITH CU WASHER 1/2" NPT(F) x 1/2" PE	
67	1	3 WAY GAUGE COCK 1/2" SW 3000lbs, CS/AS	

SERVICE : WATER, CONDENSATE ETC.

FOR BID PURPOSE ONLY

PRESSURE TRANSMITTER/ PRESSURE SWITCH
IN HFO SERVICE



BILL OF MATERIAL			
ITEM NO.	QTY./INST	DESCRIPTION	
73	A/R	INSTRUMENT CAPALLARY TUBE	
72	1	SEAL DIAPHRAGM	
69	1	1" NPS SCH-80 CS/AS NIPPLE	
71	1	2" 300 lbs ANSI FLANGE SUPPLIED ALONG WITH INSTRUMENT	
70	1	2" 300 lbs. ANSI FLANGE WELD NECK.	
68	1	1" x 2" CS/AS EXPANDER, SW	

LEGEND:

A/R - AS PER REQUIREMENT,

NOTE:

1. QUANTITY IN COLUMNS TO BE DOUBLED FOR DP MEASUREMENT.

FOR BID PURPOSE ONLY

[illegible]

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
27	15MTRS.	IMPULSE PIPE 3/4" NB, CS/AS.
26	A/R	GI PIPE, 1/2" NB.
09	2	FORGED UNEQUAL TEE AS PER ANSI B16:11 SIZE: 2 x 3/4" NB SW x 1/2" NPTF, CL 3000.
46	3	GALVANISED ELBOW CL 3000 SIZE: 1/2" NPTF.
20	1	QUICK DISCONNECTING FITTING MALE/END CONN. TO SUIT 1/2" OD CONN.
02	A/R	NYLON NOSE TO SUIT 1/2" END CONN. PR. TESTING 10 Kg/cm ² g.
14	A/R	SEAMLESS TUBE 1/2" OD, 2.1mm THICK, SS 316.
47	3	BULK HEAD COUPLING TO SUIT 1/2" OD TUBE & 1/2" NB PIPE, SS 316.
65	5	BALL VALVE 1/2" NPT(F), SS 316.
21	18	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 3000lbs, SS 316.
48	1	INSTRUMENT AIR HEADER 1" NB PIPE, SS 316.
64	1	EQUAL TEE, SS 316, TO SUIT 1/2" OD TUBE.
05	1	PR. GAUGE, 4" DIAL SIZE, RANGE 0-10 Kg/cm ² g CONNECTION 1/2" NPTM
06	1	3 WAY GAUGE COCK 1/2"NPTF x 1/2" OD.

FOR BID PURPOSE ONLY

ISSUE	BY	CH	DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.
PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

DO NOT SCALE

DATE : 23-08-2011

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

SCALE ~

APPROVED

DIV INST.

DR P.N.Z.

CH D.J.P.

DWG.NO.PE-189-IN-SK-8003

(SH. 16 OF 20)

PD

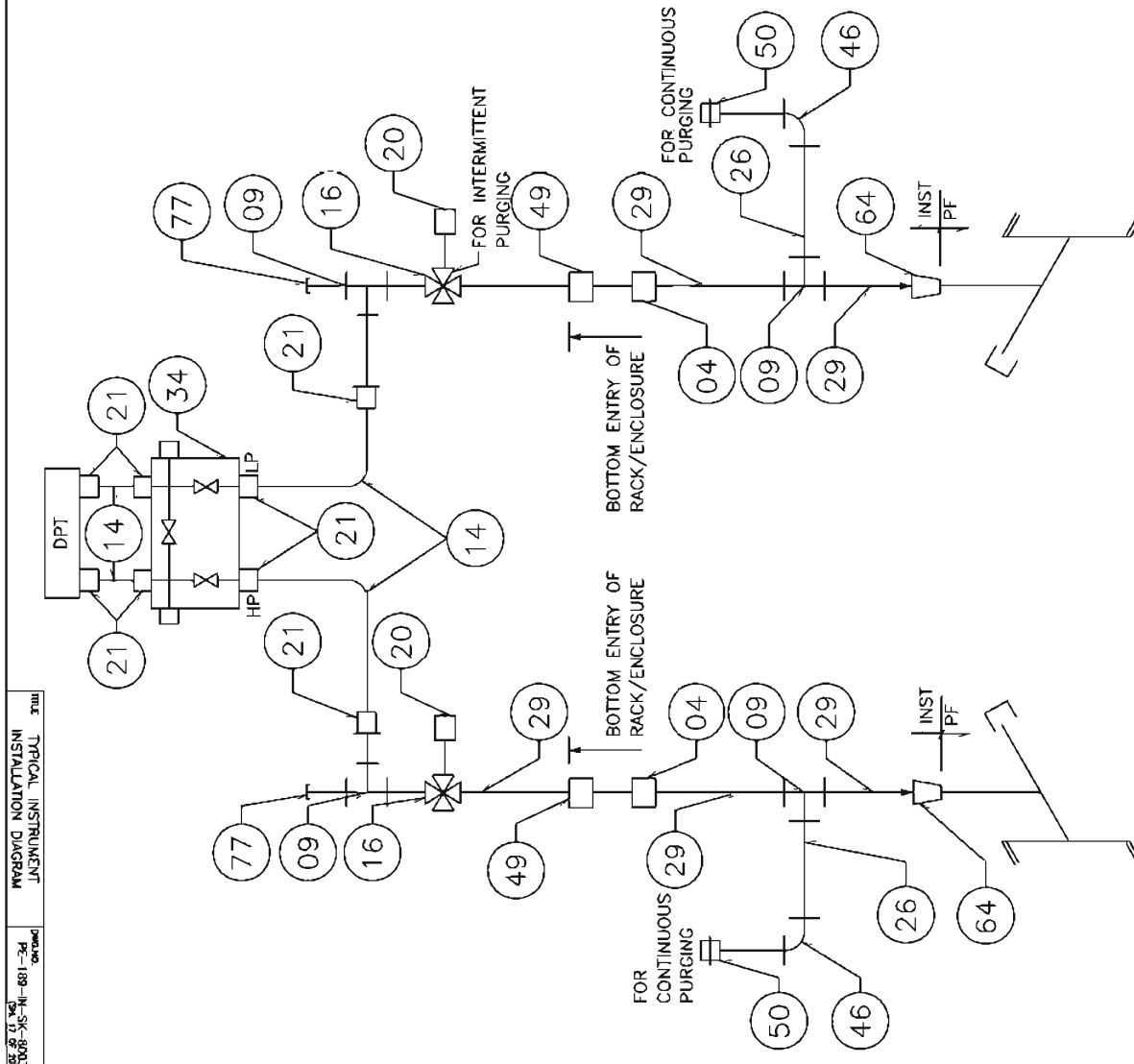
4434/2020/PS-PEM-MSX_P

BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
54	2	REDUCER 1" BSPF x 3/4" NB-SW CL 3000, CS/AS
04	2	FORGED COUPLING 3/4" SW CL 3000 AS PER ANSI B16.11
09	4	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 x 3/4" NB-SW x 1/2" NPTF, CL 3000
77	2	NIPPLE & CAP 3/4" NB-SCH 80, CAP-3/4" NPTF
14	6 MTRS.	SEAMLESS TUBE 1/2" OD, x 2.1mm THK., SS 316
16	2	FOUR WAY VALVE SIZE: (2 x 3/4" NB-SW)x(2 x 1/2"NPTF) CL-800
20	2	QUICK DISCONNECTING FITTING SIZE: 1/2"NPTM
21	8	MALE CONNECTOR 1/2" NPT(M) x TO SUIT 1/2" OD TUBE, SS 316
29	30 MTRS.	SEAMLESS PIPE 3/4" NB SCH 80
26	A/R	PIPE AS PER IS-1239 SIZE: 1/2" NB-HEAVY GRADE
34	1	3 VALVE MANIFOLD 1/2" NPT(F), SS 316
46	2	GALVANISED ELBOW CL 3000 SIZE : 1/2" NPTF
49	2	BULK HEAD COUPLING CL 3000 SIZE : 3/4" NB SW, CL 3000, AS PER ANSI B16.11
50	2	BULK HEAD COUPLING CL 3000 SIZE : 1/2" NPTF, AS PER ANSI B16.11

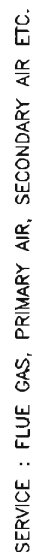
SERVICE : FLUE GAS, FURNACE ETC.

FOR BID PURPOSE ONLY

FOR BID PURPOSE ONLY			DO NOT SCALE		
MAHARASHTRA STATE POWER GENERATION CO. LTD.			PROCON ENGINEERS		
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT			(DIVISION OF M&O CONSULTING ENGINEERS PVT.LTD.)		
MUMBAI			SCALE : ~		
TYPICAL INSTRUMENT INSTALLATION DIAGRAM			APPROVED		
			DATE: 23-08-2011		
			DW. INST.		
			P.N.Z.		
			D.J.P.		
			PE-189-IN-SK-8003 (p. 17 of 28)		



TYPICAL AIR PURGING SCHEME



1. AIR PURGING ARRANGEMENT SHALL BE INCLUDED.

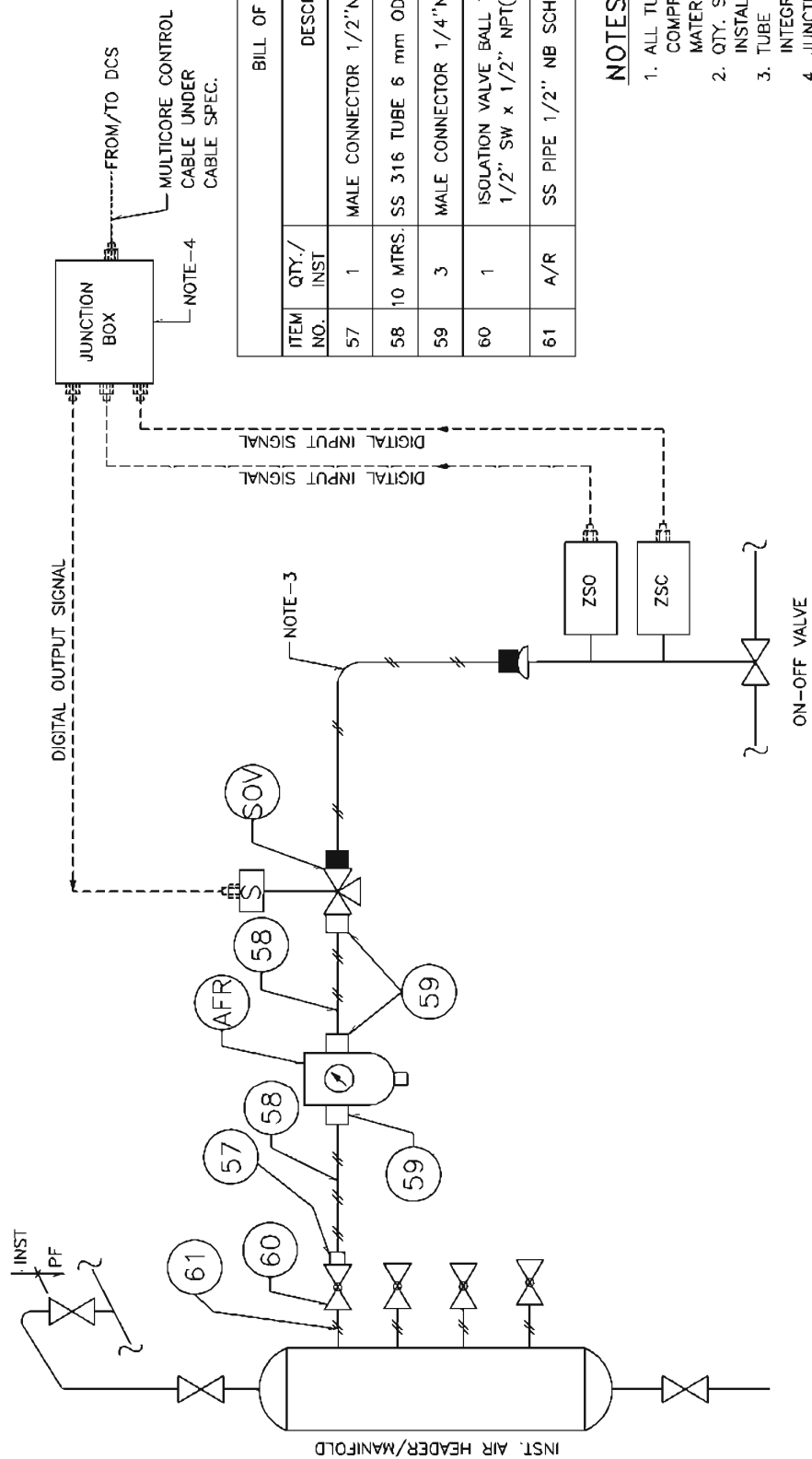
FOR BID PURPOSE ONLY

Page 525 of 534

FILE
TYPICAL INSTRUMENT
INSTALLATION DIAGRAM

PE-189-IN-SK-8003
REV. 10 OF 20

ISSUED
DATE



BILL OF MATERIAL	
ITEM NO.	DESCRIPTION
57	MALE CONNECTOR 1/2"NPT(M) x 6mm OD COMPRN.
58	10 MTRS. SS 316 TUBE 6 mm OD x 1.0mm THK.
59	MALE CONNECTOR 1/4"NPT(M) x 6mm OD COMPRN.
60	ISOLATION VALVE BALL TYPE 600 lbs 1/2" SW x 1/2" NPT(F), SS 316.
61	SS PIPE 1/2" NB SCH 40S.

- NOTES:**
1. ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
 2. QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
 3. TUBE & FITTINGS MARKED ARE INTEGRAL TO THE VALVE.
 4. JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
 5. ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

PNEUMATIC SOV HOOK UP SCHEME

- LEGEND:**
- A/R - AS PER REQUIREMENT
 - SOV - SOLENOID VALVE
 - AFR - AIR FILTER REGULATOR

FOR BID PURPOSE ONLY

FOR BID PURPOSE ONLY	
ISSUE	REVISIONS
DO NOT SCALE	
PROCON ENGINEERS (DIVISION OF KAYO CONSULTING ENGINEERS PVT. LTD.)	
SCALE	APPROVED
DATE	DATE
BY	INST.
CHK.	P.N.Z.
CH.	D.J.P.
PE-189-IN-SK-8003 (Rev. 10 of 20) P0	
MAHARASHTRA STATE POWER GENERATION CO. LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	
TYPICAL INSTRUMENT INSTALLATION DIAGRAM	

4434/2020/PS-DEM-MSX-P



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT
BHUSAWAL TPS (1 X 660MW)**

BHEL DOCUMENTS NO.: PE-TS-415-164-A001

Volume: II

Section: III

REV. NO. 00

DATE:

SECTION-III

4434/2020/PS-PEM-MSX-P



**TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT
BHUSAWAL TPS (1 X 660MW)**

BHEL DOCUMENTS NO.: PE-TS-415-164-A001

Volume: II

Section: III

REV. NO. 00

DATE:

LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID

1.0 Bidder to furnish following documents/information along with the bid (For Electrical and C&I Please Refer the Respective Section of the Specification).

- Deviation if any strictly in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed). In case of No Technical Deviation, bidder to furnish the same format stating "No Deviation" duly Stamped & Signed.
- Guaranteed Auxiliary Power Consumption Figures (Stamped & Signed with the technical offer)
- Compliance certificate. (Stamped & Signed)
- Schedule of Declaration. (Stamped & Signed)
- Un Price Schedule duly filled in. (Stamped & Signed)
- List of Start-up & commissioning spares if any. (Stamped & Signed)

Any other documents submitted by bidder except as asked in the bid's specification shall not be evaluated & considered as null & void.

NOTES:

- 1) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the works for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
- 2) All drawings/documents shall be approved by BHEL/Customer during detailed engineering stage. Successful Bidder shall comply with the comment of the customer/BHEL without any price & delivery implication.

4434/2020/PS-PEM-MSX-P



**TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT
BHUSAWAL TPS (1 X 660MW)**

BHEL DOCUMENTS NO.: PE-TS-415-164-A001

Volume: II

Section: III

REV. NO. 00

DATE:

PRE BID CLARIFICATION SCHEDULE

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				COMPANY SEAL
NAME	DESIGNATION	SIGNATURE	DATE	



**TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT
BHUSAWAL TPS (1 X 660MW)**

BHEL DOCUMENTS NO.: PE-TS-415-164-A001

Volume: II

Section: III

REV. NO. 00

DATE:

SCHEDULE OF DECLARATION

Icertify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidders Company Name

Authorized Representative's
Signature

Name

Bidder's Name

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated.

THIS IS A PART OF TENDER TECHNICAL SPECIFICATION PE-TS-415-164-A001

 SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL									
PROJECT:- BHUSAWAL TPS (1 X 660MW)									
EFFLUENT TREATMENT PLANT (ETP)									
TENDER ENQUIRY REFERENCE:-									
NAME OF VENDOR:-									
SL NO	VOLUME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF withdrawal OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF withdrawal OF DEVIATION IS APPLICABLE	NATURE OF COST OF withdrawal OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME				DESIGNATIONS			SIGN & DATE		
NOTES:									
1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.									
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.									
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.									
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.									
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.									
6. Bidder shall furnish price copy of above format along with price bid.									
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.									
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.									
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.									
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.									
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.									
12. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.									
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.									
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.									



DOCUMENT NO.:

**TECHNICAL SPECIFICATION FOR
EFFLUENT TREATMENT PLANT
BHUSAWAL TPS (1 X 660MW)**

BHEL DOCUMENTS NO.: PE-TS-415-164-A001

Volume: II

Section: III

REV. NO. 00

DATE:

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates / Inspection records etc. This is within the contracted price with extra implications to BHEL after award of the contract.
- d) All drawings / data-sheets / calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL/ Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

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

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself. Prices for special tools & tackles, if any, shall also be included in the base price.
- g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.
- h) Guarantee for plant /equipment shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities. This clause will apply in case during site commissioning additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

4/34/2020/PS-PEM-MSX-P



DOCUMENT NO.:

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- k) As built drawings shall be submitted as and when required during the project execution.
- l) That the bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

4434/2020/PS-PEM-MSX P



DOCUMENT TITLE:

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**FORMAT FOR GUARANTEED AUXILIARY POWER CONSUMPTION FIGURES
(TO BE FILLED BY THE BIDDER)**

S.NO.	List of Drives	NO OF WORKING Drives	Multiplication Factor	TOTAL GUARANTEED POWER CONSUMPTION FOR WORKING DRIVES AT MOTOR INPUT TERMINAL AFTER CONSIDERING MULTIPLICATION FACTOR (IN KW)
1.	CMB EFFLUENT TRANSFER PUMPS	02	0.6	
2.	CLEAR WATER TRANSFER PUMPS	02		
3.	FLASH MIXER STIRER	01		
4.	HRSCC SCRAPER	01		
5.	AIR BLOWERS	02		
	TOTAL POWER (KW)			

Note-Base auxiliary power consumption figure for the list of drives from sl. No. 1 to 5 (for working drives only) as indicated above has been considered as **65 KW** (after considering multiplication factor). As long as bidder's quoted guaranteed power consumption (GPC) above remains within Base auxiliary power consumption figure, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds base auxiliary power consumption figure, there shall be technical loading of bid for evaluation @ 3,00,000/- (Rupees Three lacs per Kilowatt) per KW of additional power over Base auxiliary power consumption figure.

Bidder's guaranteed power consumption as furnished above shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than Base auxiliary power consumption figure / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ 4,50,000/- (Rupees Four lacs fifty thousand per Kilowatt) per additional KW shall be levied on vendor. No benefit shall be given to bidder in case of GPC quoted is less than base auxiliary power consumption of 65 KW. Further during the performance guarantee also the base figure of 65KW shall only be considered for calculating the LD even if the GPC quoted by bidder is less than 65KW.