

 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 – 8
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415V LT SWITCHBOARD

DATA SHEET – A

<u>SR. NO.</u>	<u>ITEM</u>	<u>UNITS</u>		
1.0	<u>GENERAL</u>			
(a)	Type		Metal-clad, drawout (PCC / PMCC / MCC / SVB) Metal-clad, fixed (DB)	
(b)	Service		Indoor	
(c)	Enclosure		For ampere rating up to 1600A – degree of protection of PCC / PMCC / MCC shall be IP-54 and above 1600A the degree of protection will be IP-42	
1.1	<u>SYSTEM</u>		AC	DC
(a)	Voltage	V	415V $\pm$ 10%	220V $\pm$ 10%
(b)	Phase		3-phase and neutral	-
(c)	Combined voltage and frequency variation		$\pm$ 10% (absolute sum)	-
(d)	System grounding		Solidly grounded	Ungrounded
1.2	<u>RATED CURRENT AT 50°C AMBIENT</u>			
(a)	Busbar		* By Bidder	
(b)	Circuit breaker		* By Bidder	
(c)	Switches		16A to 400A	

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<u>SR. NO.</u>	<u>ITEM</u>	<u>UNITS</u>		
1.3	<u>SHORT CIRCUIT RATING</u>		AC	DC
(a)	Interrupting	kA	50 kA	25* kA
(b)	Short Time for 1 second	kA	50 kA	25* kA
1.4	<u>HV FOR 1 MINUTE (MIN.)</u>	kV	2.5 kV	1.5 kV
(a)	Indicative only; the actual value will be decided by the Bidder, after substantiating the same by calculation.			
1.5	<u>A.C./D.C. POWER SUPPLY</u>			
(a)	Control Voltage for Circuit breaker	V	220V DC $\pm$ 10%	
(b)	Control voltage for MCC modules	V	240V AC $\pm$ 10%, 1 Ph, 50 Hz $\pm$ 5%	
(c)	Service voltage	V	240V AC $\pm$ 10%, 1 Ph, 50 Hz $\pm$ 5%	
2.0	<u>CIRCUIT BREAKER</u>			
2.1	<u>DUTY CYCLE</u>		0-3'-CO-3'-CO	
2.2	<u>BREAKING CURRENT</u>			
(a)	A.C. Symmetrical	kA	50 kA	
2.3	<u>MAKING CURRENT</u>	kA	125 kA Peak	
2.4	<u>AUXILIARY VOLTAGE</u>			
(a)	Closing	V	220V D.C. (85 - 110%)	
(b)	Tripping	V	220V D.C. (70 - 110%)	
(c)	Spring Charging	V	220V D.C. (85 - 110%)	
3.0	<u>CONTACTOR DUTY</u>		AC	DC

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	DOCUMENT TITLE CONDUITS AND PIPES	SPECIFICATION NO. PES-507-27	
		VOLUME II B	
		SECTION D	
		REVISION 0	DATE: 27/10/2010
		SHEET 1	OF 6

**GENERAL TECHNICAL REQUIREMENTS
OF
CONDUITS AND PIPES
SPECIFICATION NO. PES-507-27
REV 0**



DOCUMENT TITLE
CONDUITS AND PIPES

SPECIFICATION NO. PES-507-27

VOLUME II B

SECTION D

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1.0 GENERAL

1.1 This specification covers the manufacture, inspection & testing at vendor's works and delivery to site of conduits, pipes and their fittings for electrical installation.

2.0 CODES AND STANDARDS

2.1 The material, constructional features and various processes involved in manufacture shall comply with currently applicable Indian Standards.

2.2 The following Indian Standards shall be applicable, in general. However if Data Sheet A specifies conformance to other international standards, the equivalent IEC/BS/other standards shall be considered.

- a) IS:9537 (All Parts) Conduits for electrical installation.
- b) IS:3480 Flexible steel conduits for electrical wiring.
- c) IS:6946 Flexible non-metallic conduits for electrical installation.
- d) IS:1239 Mild steel tubes, tubulars and other wrought steel fittings.
(for size above 63mm dia of rigid conduits)
- e) IS:2667 Fittings for rigid steel conduits for electrical wiring.
- f) IS:3837 Accessories for rigid steel conduits for electrical wiring.
- g) IS:3419 Fittings for rigid non-metallic conduits.
- h) IS:6005 Code of practice for phosphating iron & steel.
- i) IS:2629 Recommended practice for hot dip galvanizing on iron and steel.
- j) IS:4759 Specification for hot dip zinc coatings on structural steel and allied products.
- k) IS:6745 Methods for determination of mass of zinc coating on zinc coated iron and steel articles.

3.0 DESIGN REQUIREMENTS AND CONSTRUCTIONAL FEATURES

The conduit and conduit accessories shall include conduit plugs & caps, gaskets and box cover etc in addition to any specific requirement given in Data Sheet A. The diameter of conduits and accessories shall be uniform throughout the length.

3.1 Rigid Conduits and Fittings

3.1.1 Rigid conduits shall generally conform to the requirements of IS:9537 (Part I & Part II). However conduits above 63mm diameter shall conform to the requirements of IS:1239. Unless specified otherwise in Data Sheet A, all conduits and pipes shall be of medium duty.



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3.1.2 The rigid conduits shall be hot dip galvanized inside and outside. Weight of zinc shall be as per IS:4759. Conduits shall be thoroughly cleaned and pretreated, conforming to IS:6005.

3.1.3 Conduits shall be supplied in approximate length as specified below

a) Rigid Conduits 5 metres

b) Flexible Conduits 10 - 30 metres

3.1.4 Each end of conduit length shall be threaded. The ends of conduits shall be sealed with protective caps to prevent damage to threaded portions and entrance of moisture and foreign material.

3.1.5 The inside surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.

3.1.6 Conduit fittings shall be made out of tube or cast to the shape as to match with corresponding conduit sizes and meet their purpose without any special adjustment.

3.1.7 All fittings shall be screwed type and hot dip galvanized inside and outside.

3.2 Flexible Metallic Conduits and Fittings

3.2.1 Flexible metallic conduits shall generally conform to the requirements of IS:3480.

3.2.2 Flexible conduits shall be made of strip steel which shall be of cold rolled mild steel. The strip shall be of uniform width and thickness throughout.

3.2.3 The strip shall be electro galvanized to a minimum thickness of 25 microns as specified in IS:3480. The surface of the strip shall be thoroughly cleaned before application of protective coating. Pretreatment, before galvanization, shall conform to IS:6005.

3.2.4 The strip for making flexible conduit shall be wound tightly and so overlapped in subsequent helicals that no openings are seen in normal position.

3.2.5 Flexible conduits shall be lead coated for application in high temperature zones, if specifically mentioned in Data Sheet A.

3.2.6 The conduit shall have uniform diameter throughout its length. The internal surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.

3.3 PVC Conduits

3.3.1 PVC conduits shall generally conform to the requirements of IS:9537(Part I & Part III).

4.0 INSPECTION

4.1 The following stages of manufacture shall be stage inspected by Purchaser or his duly authorized representative.

4.1.1 Inspection of manufacturing processes such as shearing, punching, bending, welding, galvanizing etc.

4.1.2 Inspection of packing material and procedure.



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4.1.3 Inspection of finished product.

4.2 The inspection will be carried out as per agreed quality plan.

5.0 TESTING

5.1 Rigid Conduits

a) Acceptance Tests - as per IS:9537 Part 1 & 2 upto 63mm OD
- as per IS:1239 above 63mm OD

i) Dimension checks

ii) Bending test (below 32mm OD)

iii) Compression test

b) Special Tests (as acceptance test) as applicable to galvanizing.

5.2 Flexible Steel Conduits

a) Acceptance Tests - as per IS:3480

i) Dimension checks

ii) Linear breaking test

iii) Test for flexibility

iv) Bend fracture test

v) crushing test

b) Special Tests (as acceptance test) as applicable to galvanizing.

5.3 PVC Conduits

a) Type Tests - as per IS : 9537 (Part 1 & 3)

i) Dimension checks

ii) Bending test

iii) Compression test

iv) Impact test

v) Collapse test

vi) Resistance test

vii) Resistance to burning



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viii) Electrical Characteristics

b) Acceptance tests - as per IS:9537 (Part 1 & 3)

i) Dimension checks

ii) Bending test

iii) Compression test

iv) Collapse test

v) Resistance to burning

vi) Electrical characteristics

5.4 Sampling for the tests shall be done as per applicable standards mentioned above.

5.5 The testing shall be carried out as per agreed quality plan.

6.0 PACKING

6.1 The material shall be packed as per manufacturer's standard. Packing procedure shall be to the purchaser's approval.

7.0 DRAWING, DATA AND DOCUMENTS REQUIRED

7.1 The following information shall be furnished within two weeks of award of contract, for purchaser's approval.

a) Manufacturing drawings/details.

b) Recommended Field quality plan covering site handling, storing, laying etc.

c) Final quality plan.

7.3 The following information shall be furnished after testing and inspection

Type Test, routine test and special test certificates in bound volume in requisite number.



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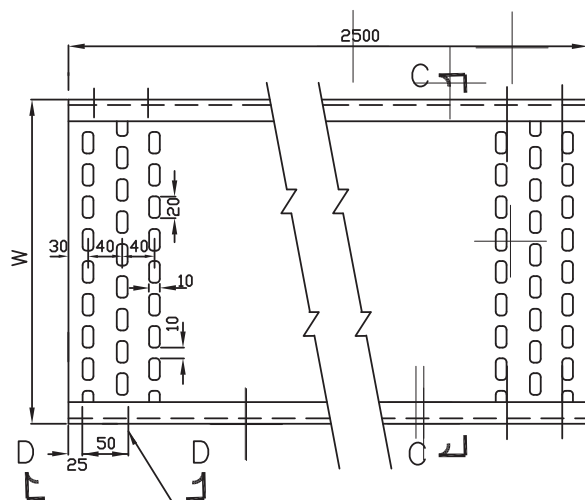
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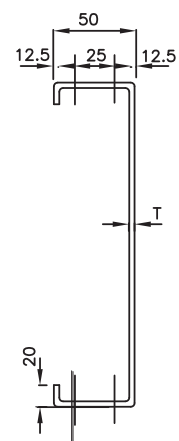
DATASHEET A

SPECIFIC TECHNICAL REQUIREMENTS

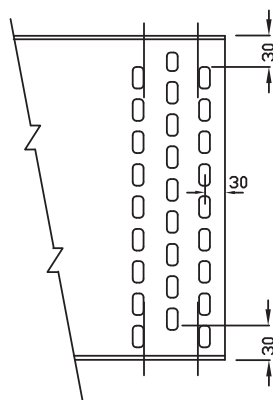
- 1.0 APPLICABLE STANDARDS: IS:9537, IS: 1239, IS:3480
- 2.0 RIGID STEEL CONDUITS & STEEL PIPES
- a) Material: Cold rolled mild steel to IS:226
 - b) Applicable standard
 - i) Upto 63mm OD: IS:9537 Part I & II
 - ii) Above 63mm OD: IS:1239
 - c) Surface treatment: Hot dip galvanizing inside & outside as per IS:2629
 - d) Wt. of zinc: as per IS 4759
 - e) Duty: Medium
 - f) Fittings: Screw type as per IS:2667
- 3.0 FLEXIBLE CONDUITS:
- a) Material: Strip steel cold rolled and annealed
 - b) Standard applicable: IS: 3480
 - c) Surface treatment: Electro galvanized as per IS: 3480
 - d) Whether lead coated: YES
 - e) Minimum thickness: 25 microns
of zinc coating
- 4.0 PVC CONDUITS
- a) Material: PVC
 - b) Applicable standard: IS: 9537 (Part I & III)



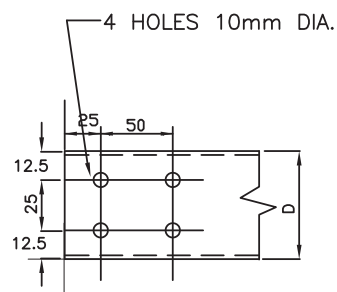
4 HOLES 10mm DIA.



SECTION-CC
(100/50 TRAYS)



ARRANGEMENT OF
PERFORATIONS



VIEW-DD
(100,50W TRAYS)

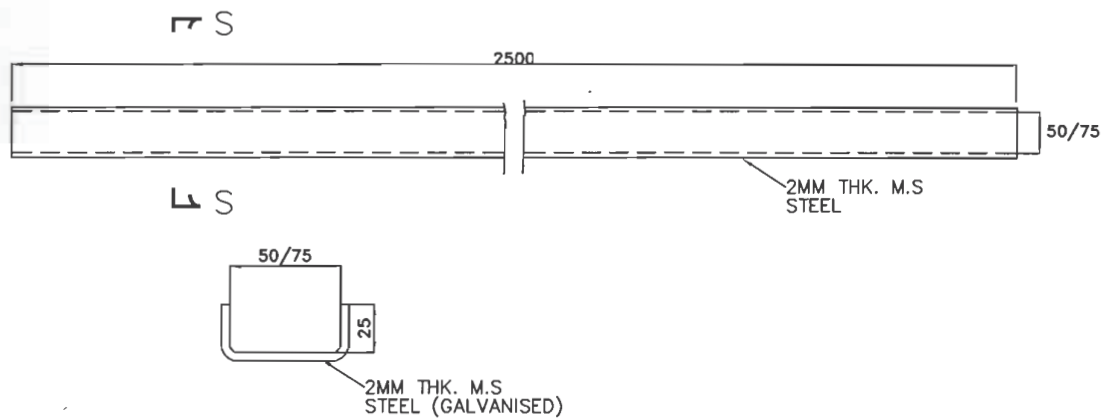
TRAY WIDTH W (mm)	100	50
TRAY DEPTH D (mm)	50	50
T (mm)	2	2

PERFORATED TYPE TRAY



TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES

DWG. NO.



SECTION S-S

CABLE TROUGHS



TYPICAL DETAILS OF
CABLE TRAY AND ACCESSORIES

BHEL DRAWING NO.

	1X660 MW BHUSAWAL TPP # 6 COMPRESSED AIR SYSTEM TECHNICAL SPECIFICATION (C&I PORTION)	SPECIFICATION No: PE-TS-415-555-A001	
		SECTION : IC	
		REV. 01	DATE: 30.01.2020
		SHEET: 1 OF 1	

SECTION: IC
TECHNICAL SPECIFICATION (C&I PORTION)

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
CONTROL AND INSTRUMENTATION SPECIFICATION FOR COMPRESSED AIR SYSTEM		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
<u>TABLE OF CONTENTS</u> A. General & Specific Technical requirement B. C&I deliverables list C. Specification for Motorized valve actuator D. Specification for field instruments E. Control panels specification F. Applicable codes and standards G. Mandatory spares H. Drawings		

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

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
GENERAL REQUIREMENT 1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems. 2.0. The quantity of instruments for auxiliary system shall be as per tender P & ID, wherever provided, for the respective system as a minimum for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication. 3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering. 4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc. for external connection including spare contacts shall be wired out to suitably located junction boxes. 5.0 In case of any contradiction most stringent clause/condition shall prevail. 6.0 Any part/module of the C&I system which are not listed under recommended spares shall be deemed as having life expectancy not less than the expected life of the plant i.e. 30 years.		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
Specific Technical Requirements (C&I): 1) Operation and control of compressed air system shall be as per design philosophy given elsewhere in the specification. Integrated microprocessor based control system shall be provided for each Instrument Air compressor & Service air compressor. DCS (in BHEL's scope of supply) based master control system for all compressors, driers shall be provided . The DCS panels shall be located in the compressor control room. All PT, DPT, TE (including winding and bearing temperature of compressor motor) outside the compressor skid shall also be hooked up to this system. Redundant MODBUS (on RS-485) link shall be provided between plant DCS & this microprocessor system for monitoring of all the parameters of compressed air system. In addition to the MODBUS link, provision for hardwired START, STOP, LOAD & UNLOAD commands from DCS to all the compressors & their status feedbacks shall also be provided. All necessary hardware and software shall be under the bidder's scope. Bidder to confirm all the above requirements stated above in their scope of supply. Group control is envisaged in DCS to clock more or less equal number of running hours for each Compressor. Bidder to furnish write-up & logics for group control of compressors. Additional 3 nos.laptop loaded with engineering software shall be provided by Bidder. 2) All individual compressor and drier local panels shall be hardwired interfaced in addition to soft link connectivity with the DCS (master controller). 3) Compressors and driers shall be controlled from local control panel(microprocessor based/PLC) to be located on compressors and dryer units (non-air conditioned area). Control and protection logic will be implemented in the local panels. 4) Individual gauge board (as per manufacturer's standard) shall be provided near each compressor where pressure, temperature and flow gauges are to be mounted for local indication of all important parameters such as pressure,temperature, flow related to the compressor. 5) Individual gauge board (as per manufacturer's standard) shall be provided near each Air Drying plant for local indication of all important parameters such as pressure, temperature, flow related to the driers. 6) Bidder shall provide all measuring instruments with required accessories for control, monitoring, protection and interlock of the compressors and driers. Electronic analog signal transmission from field transmitters to area control rooms shall be 4-20 mA DC. All process switches, limit switches and drive feed back signals shall be provided with potential free contact. Temperature detector will be provided at each stage of the compressed air system and cooling water system of compressors for monitoring in the local control panel. a) The control system shall meet the requirement of monitoring, sequential		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
starting/stopping of drives, interlock and protection, individual/sequential control metering, annunciation and on-line and all other routine functions with minimum operator's intervention. b) In line flow gauge & flow switch shall be provided on the cooling water line of the compressed air system. 7) Dew point measurement shall be provided for each Air drying plant of Compressed air system. The output of the instrument shall be 4-20 mA DC to be connected to the master controller panel. 8) The software and hardware for offered PLC/microprocessor system shall be of latest version and shall be upgradable. Bidder to ensure the availability of spares and service support for the offered PLC/microprocessor system for minimum 20 years after guarantee period. The software tool shall have facility to interface with third party software packages. Easy up gradation and future expansion facility shall be available. All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant and shall be in the name of customer. User shall not have to pay any recurring license fee during the usage period of the system. It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life. 9) All electrical actuators shall be integral type. 10) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with. 12) The solenoid valves shall have limit switches for open/close feedback. 13) Interface of MCC, HT SWGR, Actuators etc. with PLC/microprocessor based control system shall be as per Drive Control Philosophy attached in the specification. 14) All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope. RTD's shall be of duplex type. 15) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification.		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
16) Redundant 230 VAC UPS feeders shall be provided by BHEL at a single point. Further distribution to various instruments/PLC/microprocessor etc. shall be in Bidder's scope. Bidder to include necessary power distribution board (ACDB) (as per details attached elsewhere in this specification) in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder from the above supply and all necessary hardware for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid. 17) Bidder shall provide Customer training on the proper application and maintenance of PLC/Microprocessor Hardware & Software at Vendor's work or at Bhusawal site. 18) Following documents to be furnished by the bidder along with the bid: • Proposed PLC/Microprocessor system configuration drawing with write-up • Duly stamped and signed copy of Quality Plan. • Product catalogues and specifications for PLC/Microprocessor as well as HMI application. • Requirement of electronic earthing, if any, for PLC based control system 19) Bidder to comply with codes and standards as mentioned in the specification. 20) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible. 21) Bidder to delegate /depute their persons/experts as per owner/consultants' requirement. 22) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system. 23) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.		

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7.2	<u>CONTROL CONCEPT OF COMPRESSORS</u>	
7.2.1	Each compressor shall be controlled by dual control method to maintain receiver pressure within narrow limits. Dual control method permits the operation of a compressor in either of the two following ways: (a) Continuous run load - unload control. (b) Automatic start/stop control. One selector switch for each compressor shall be provided in the control panel to achieve any of the above controls. Each selector switch shall have three positions: "base duty" (Load-Unload control), "Standby duty" (Auto-start/stop control) and "Stop". Each compressor shall operate in 50% or 100% load under load/unload mode of control depending on system demand. The compressors shall be primarily controlled from local control panels and status indication of the same shall be provided on local control panel as well as on the operators' station in central control room (CCR). Other details of control concepts are elaborated in Volume-V.	
7.3	<u>INTERFACING WITH PLANT DCS</u>	
	There shall be one common PLC based control panel for compressors and driers. The common panel shall be located in the compressor room. One (1) operating cum programming station with 24" TFT monitor and printer shall be provided with this common panel. All individual compressors and drier local panels shall be hardwired interfaced with this common PLC panel. Required Hardware/soft link interface between common PLC panel and DCS is foreseen for remote operation, monitoring and alarm. Air conditioner (split type) of suitable capacity with standby arrangement shall be provided to PLC based control panel room.	
7.4	<u>ANNUNCIATION SYSTEM</u>	
7.4.1	Annunciation shall be provided for following conditions for the compressed air system : (a) Compressor motor tripped	

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(b) Lub oil pressure - low (c) Air temperature at inlet of after cooler-high (d) Air temperature at outlet of after cooler-high (e) Air temperature at outlet of inter cooler-high (f) Air Pressure in receiver-high and low (g) Cooling water flow to compressor – low (h) Cooling water pressure - low (i) Bearing and winding temperature of compressor motor - high and very high (j) Air pressure after cooler - high (k) Compressor discharge pressure - high and low (l) Air pressure low (common for a group of compressors) (m) Cylinder jacket cooling water outlet temperature - high (n) Lub Oil temperature - high (o) Any other annunciation as may be necessary for safe and trouble free operation of the system. 7.5 <u>INTERLOCK</u> 7.5.1 The following safety interlocks shall be provided for the compressed air system : (a) Compressor trip on low lube oil pressure (b) Compressor trip on high air temperature at compressor discharge		

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(c) Compressor trip on high cylinder jacket water temperature (for water cooled compressors) (d) Compressor start only after coolant flow is established (e) Compressor trip due to low cooling water flow (f) Stand by compressor shall start on auto mode when running compressor trips or on low preset air header pressure. The compressor (standby) shall stop automatically if it runs for half an hour in unloaded condition. (g) Any other interlock as required for safe and reliable operation of the system. (h) Compressor shall have auto/manual mode of selection. (i) The compressor shall trip by operating local lock-out switch or when any motor protection device is operated. (j) The compressor shall be started in unloaded condition as the loading /unloading solenoid valve is kept in de-energized condition through a timer. As soon as the compressor motor reaches its full speed, the timer shall switch on the loading/unloading control circuit. Depending upon the requirement of header pressure, the pressure switch shall energize/de-energize the compressor loading/unloading solenoid valves & in-turn the compressor shall load the receiver or run in unloaded condition. 7.5.2 All pressure and temperature conditions used for tripping the compressor shall be provided with pre-trip annunciation in the local control panel 7.6 <u>PERFORMANCE GUARANTEE</u> 7.6.1 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in this specification. All compressor units and accessories shall be guaranteed to operate without pulsation, noise or vibration while operating in isolation as well as in parallel with other compressor.		

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7.6.2	All compressor unit and accessories shall be guaranteed for capacity, pressure and power consumption for specified capacity and pressure either in isolation or during parallel operation.	
7.6.3	Drying plant capacity shall be guaranteed for the dew point of minus (-) 20 °C at atmospheric pressure at the dryer outlet as specified in data specification sheet.	
8.0	<u>DRAWINGS, DATA, INFORMATION & MANUALS</u>	
8.1	For Drawing, Data and Information required along with BID, please refer Volume VIII.	

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5.0 **COMPRESSED AIR PLANT**

5.1 **GENERAL**

5.1.1 Instrument air and service air compressors, shall have their own local proprietary microprocessor based controls with touch screen pad. There

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shall be one common PLC based control panel/control desk with all necessary push buttons, lamps, switches, annunciator etc. for all compressors and driers. This common panel shall be located in the compressor control room. One number operating cum programming station with 24" TFT monitor and printer shall be provided with this common PLC panel. All control commands for individual compressor and drier from common PLC panel to local panels shall be hardwired as well as through soft link and all monitoring signals shall be through soft link. 5.1.2 Required hardware & soft communication cable, interface between common PLC panel and DCS shall be provided by bidder for remote operation, monitoring & alarm. 5.1.3 Compressors and driers shall be controlled from PLC control panel/ control desk . 5.1.4 Individual gauge board shall be provided near each compressor where pressure, temperature and flow gauges are to be mounted for local indication of all important parameters such as pressure, temperature, flow related to the compressor. 5.1.5 Individual gauge board shall be provided near each Air Drying plant for local indication of all important parameters such as pressure, temperature, flow related to the driers. 5.1.6 Bidder shall provide all measuring instruments with required accessories for control, monitoring, protection and interlock of the compressors and driers as per the P&I Drawings. Electronic analog signal transmission from field transmitters to area control rooms shall be 4-20 mA DC. All process switches, limit switches and drive feed back signals shall be provided with potential free contact. Temperature detector will be provided at each stage of the compressed air system and cooling water system of compressors for monitoring in the local control panel as well as in DCS at CCR. (a) The PLC system shall meet the requirement of monitoring, sequential starting/stopping of drives, interlock and protection, individual/sequential control metering, annunciation and on-line monitoring including electrical power distribution systems and all other routine functions with minimum operator's intervention.		

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(b) In line flow gauge & flow switch shall be provided on the cooling water line outlet of the compressed air system. 5.1.7 Dew point measurement shall be provided at the outlet of each compression type Air drying plant of compressed air system. The output of the instrument shall be 4-20 mA DC to be connected to the common PLC panel. 5.1.8 Annunciation windows and hooter will be driven from PLC output card and required annunciation sequence will be programmed in application software of PLC system. Bidder shall provide necessary alarm/annunciations in the local panel as well as repeat annunciation to remote DCS for safe and trouble free operation of the system. 5.1.9 For detail operation and control philosophy, refer VOLUME IIIG/SECTION-1. 5.1.10 For detailed PLC specifications refer Volume-V/Section-5.		

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

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT							
1X660 MW BHUSAWAL TPP							
DOCUMENT NUMBER PE-GL-415-145-1100							
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION							
1	PE-V9-408-XXX-1901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I	
2	PE-V9-408-XXX-1902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I	
3	PE-V9-408-XXX-1903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I	
4	PE-V9-408-XXX-1904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I	
5	PE-V9-408-XXX-1905	QUALITY PLANS (Tx and Analyser)	A	-	VENDOR	C&I	
PLC/MICROPROCESSOR PANEL							
1	PE-V9-408-XXX-1906	PLC/MICROPROCESSOR CONFIGURATION DRAWING	A	A	VENDOR	C&I	
2	PE-V9-408-XXX-1907	PLC/MICROPROCESSOR PANEL GA (INTERNAL & EXTERNAL) DRAWING	A	-	VENDOR	C&I	
3	PE-V9-408-XXX-1908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I	
4	PE-V9-408-XXX-1909	PLC/MICROPROCESSOR INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I	
5	PE-V9-408-XXX-1910	UPS BATTERY CHARGER/ BATTERY DATASHEET & SLD	I	\$\$	VENDOR	C&I	
6	PE-V9-408-XXX-1911	UPS SIZING CALCULATIONS	I	-	VENDOR	C&I	
7	PE-V9-408-XXX-1912	BATTERY SIZING CALCULATIONS	I	-	VENDOR	C&I	
8	PE-V9-408-XXX-1913	CONTROL DESK LAYOUT / GA DRAWING	A	-	VENDOR	C&I	
9	PE-V9-408-XXX-1914	PLC/MICROPROCESSOR-OWS/PRINTER FURNITURE BOM	A	-	VENDOR	C&I	
10	PE-V9-408-XXX-1915	PLC CONTROL ROOM LAYOUT DRAWING	A	-	VENDOR	C&I	
11	PE-V9-408-XXX-1916	PLC/MICROPROCESSOR CATALOGUE	I	-	VENDOR	C&I	
12	PE-V9-408-XXX-1917	PLC/MICROPROCESSOR QUALITY PLAN & FAT PROCEDURE	A	-	VENDOR	C&I	
13	PE-V9-408-XXX-1918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	,	VENDOR	C&I	
14	PE-V9-408-XXX-1919	PROCESS GRAPHIC MANUSCRIPTS PLC/MICROPROCESSOR	I	-	VENDOR	C&I	
15	PE-V9-408-XXX-1920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I	
16	PE-V9-408-XXX-1921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I	
17	PE-V9-408-XXX-1923	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	-	VENDOR	C&I	
18	PE-V9-408-XXX-1924	PANEL HEAT DISSIPATION DATA	I	-	VENDOR	C&I	
19	PE-V9-408-XXX-1925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I	
20	PE-V9-408-XXX-1926	PLC/MICROPROCESSOR O & M MANUAL	I	-	VENDOR	C&I	
21	PE-V9-408-XXX-1927	PLC/MICROPROCESSOR EARTHING SCHEME	I	-	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					

	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
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1.0 SCOPE

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.

2.0 STANDARDS

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

3.0 SERVICE CONDITIONS

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.

4.0 RATING

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 PERFORMANCE

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 SPECIFIC REQUIREMENT

6.1 CONSTRUCTION

- 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.		

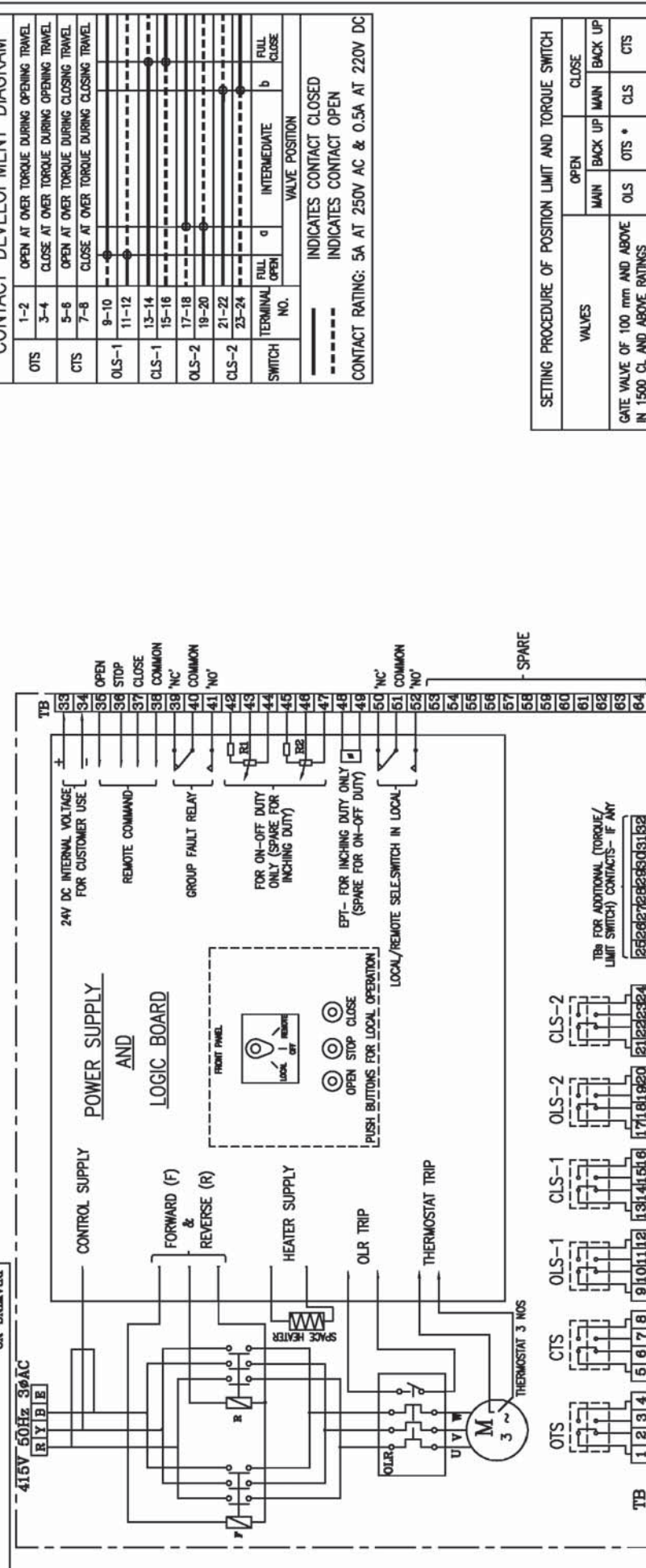
CONSULTANT : PROCON ENGINEERS

 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 – 12
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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.

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

TYPE OF PRODUCT ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS
OR NAME OF CUSTOMER/PROJECT
BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT,
TRUCHIRAPPALLI-800014.

DEPT	VL	SCALE	WEIGHT (KG)	REFERENCE INFORMATION	DATE	NO. OF VAL
365-121					07.10.04	
CODE					07.10.04	
TITLE					07.10.04	
REV	DATE	ALTERED				
		CHD & APPD				
WIRING DIAGRAM (TERMINAL PLAN)					DRAWING NO.	REV
FOR ACTUATOR WITH INTEGRAL STARTER					3-V-MISC-24227	0
					CARD CODE	
					U 01	

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	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR FIELD INSTRUMENTS		

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
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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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REV: R0	CONTROL & INSTRUMENTATION		Page 222 of 718
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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S.R. 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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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 224 of 718
SR. NO.	ITEM	DESCRIPTION	
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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		MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0		CONTROL & INSTRUMENTATION	Page 225 of 718
SR. NO.	ITEM	DESCRIPTION	
		(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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	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
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SR. NO.	ITEM	DESCRIPTION	
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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	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 227 of 718
SR. NO.	ITEM	DESCRIPTION
		(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	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
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SR. NO.	ITEM	DESCRIPTION	
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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S.R. NO.	ITEM	DESCRIPTION
1.6	<u>MASS FLOW METER (FOR AIR)</u>	
1.6.1	Sensor	Thermal dispersion
1.6.2	Measuring Principle	The typical thermal mass sensing element contains two thermowell-protected Resistance Temperature Detectors (platinum RTDs). When placed in the process, one RTD is heated and the other RTD senses the process temperature. The temperature difference between the two RTDs is related to the process flow rate as well as the properties of the process medium.
1.6.3	Primary Element	316 stainless steel body with Hastelloy C thermowell sensors, 316 stainless steel compression fitting with teflon or stainless steel ferrule
1.6.4	Pressure (Maximum Operating with Damage)	
1.6.4.1	Stainless Steel Ferrule	-18°C to 121°C
1.6.4.2	Teflon Ferrule	-18°C to 93°C
1.6.5	Process Connection	1/2" MNPT or 3/4" MNPT with stainless steel or Teflon ferrule
1.6.6	Transmitter	
1.6.7	Measured quantities	Mass Flow rate, Total Mass Flow
1.6.8	Input Signal Processing	Digital Processing.
1.6.9	Display	LCD, ± 9999 counts, user scalable to flow rate

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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) ½" 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 ± 1.0%.	
		(b) Accuracy of set point Indication:±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.	

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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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		modulating purposes. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.	
1.19.3	Supply Air	7 Kg / cm ² .	
1.19.4	Selection	Based upon thrust/torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc Provision for air-to-open and air-to-close operation.	
1.19.5	Casing	IP-65.	
1.19.6	Accessories	(a) Air lock relay.	
		(b) Hand wheel.	
		(c) Air filter regulator with gauge.	
		(d) Volume Booster.	
		(e) Limit Switches.	
		(f) Smart Positioner with Input and Output pressure gauges, local keypad & display.	
		(g) Solenoid Valve.	
		(h) Integral non contact type position Transmitter. (4-20 mA DC linear output)	
		(i) Junction box with cable gland.	
1.19.7	Fail-safe operation	For regulating duty- stay put against	

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		power & air fail.	
1.19.8	Repeatability	Better than 0.5% of full travel.	
1.19.9	Hysteresis	Less than $\pm 1\%$ of full travel.	
1.19.10	Operating Temp. limit	80 Deg. C (min.)	

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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	± 2% of full scale detection or better for on-line type and ±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.	

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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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S.R. NO.	ITEM	DESCRIPTION
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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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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2.1.10	Enclosure	Transparent cover.	
2.1.11	Connection	Screw terminals.	
2.1.12	Mounting	Projection mounting inside panel / DIN rail mounting.	
2.2	<u>DISTRIBUTION BOARDS</u>		
2.2.1	Type	Fixed, Modular.	
2.2.2	Power distribution	Through MCCB.	
2.2.3	Enclosure	Sheet Steel, IP54.	
2.2.4	Mounting	Free standing (Can be attended from both front & back).	
2.3	<u>RECEIVER RECORDER</u>		
2.3.1	Type	Microprocessor Based continuous video chart type. (Paper less)	
2.3.2	Display type	320 x 240 pixels high resolution coloured LCD graphics.	
2.3.3	Number of pen	2/4 as applicable.	
2.3.4	Input	4-20mA DC/1-5 Volt/ RTD/ Thermocouple.	
2.3.5	Display span rate	1, 5, 10, 20, 30 and 60 min / div. Selectable.	
2.3.6	Digital indication	Measured values with engineering unit.	
2.3.7	Trends	Coloured display on screen.	

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2.3.8	Colour of trends	Selectable.
2.3.9	Performance	
(a)	Accuracy	±0.1% of span or better. (Indication & Recording)
(b)	Updation rate	1 Sec or better.
2.3.10	Input open circuit	Up/Down Scale. (selectable)
2.3.11	Reference Junction Compensation	Built-in cold junction compensation for thermocouple inputs.
2.3.12	Power Supply	240 Volt, 1 Ph, 50 Hz A.C.
2.3.13	Operating ambient temperature range	0-50 °C. (maximum)
2.3.14	Face Dimension	144 mm (W) x 144 mm (H).
2.3.15	Depth	300 mm (typical).
2.3.16	Construction	Case - drawn steel, Bezel- Polycarbonate.
2.3.17	Readable distance	3 meters (minimum)
2.3.18	Mounting	Flush panel.
2.3.19	Accessories	Engraved phenolic nameplate affixed to front flange to identify each recorder by tag number and each pen by color and measured variable. Shunt resistors, Ethernet port, RS232/422a/ 485 port.
2.3.20	Features	(i) Hi, Hi-Hi, Lo and Lo-Lo contacts each channel.

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2.3.21		(ii) 2 MB memory for Data acquisition and 100 MB Zip disk.
		(iii) 3 ½" Floppy disk.
		(iv) Computation functions like linear scaling, square root, differential and engineering unit and all other mathematical functions.
		(v) Memory status display, LCD backlight saver.
		(vi) Event sampling typically 125, 250, 500 msec.
2.4	<u>MULTIPOINT RECORDER</u>	
2.4.1	Type	Microprocessor Based continuous video chart type. (Paper less)
2.4.2	Number of Points	6,12 or 24. (as required)
2.4.3	Input	4-20 mA/1-5V/Thermocouple/RTD.
2.4.4	Recording	Channel number or dot with different color for each channel.
2.4.5	Point Selection	Programmable for any combination of points by selection.
2.4.6	Readable Distance	3 meters. (minimum)
2.4.7	Data Display	Channel number, alarm status, measured data and engineering data (or Programming Display) in green LEDs.

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2.4.8	Face Dimension	(i) 144 x 144 mm (approx.) for 6 point.	
		(ii) 252 x 206 mm (approx.) for 12 point.	
		(iii) 305 x 380 mm (approx.) for 24 point.	
2.4.9	Reference Junction Compensation	Built-in.	
2.4.10	Mounting	Flush Panel.	
2.4.11	Performance		
(a)	Accuracy	$\pm 0.5\%$ of span or better.	
(b)	Ambient Temperature effect	$\pm 0.3\%$ of span for 10 °C variation or better.	
(c)	Supply voltage variation effect	$\pm 0.2\%$ of span for 10% variation in supply voltage or better.	
(d)	Frequency variation effect	$\pm 0.1\%$ of span for 2 Hz variation in frequency or better.	
(e)	Operating Position effect	$\pm 0.1\%$ of span for 0-30 Deg. inclined or better.	
2.4.12	Input Open Circuit	Up/Down Scale.	
2.4.13	Power Supply	240 Volt, 1 Phase, 50 Hz AC.	
2.4.14	Operating Conditions :-		
(a)	Temperature	0-50 °C.	
(b)	Relative Humidity	25%-90%.	

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