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LIST
OF
C&I DOCUMENTS/
DELIVERABLES

LIST OF VENDOR DELIVERABLES FOR C&I FOR CPU SYSTEM			
SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-412-155-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-412-155-I902	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DCS)	A
3	PE-V0-412-155-I903	HMI PICTURES/PLANT SCHEMATICS	I
4	PE-V0-412-155-I904	INSTRUMENT SCHEDULE with set points	A
5	PE-V0-412-155-I905	GROUPING AND TERMINATION	A
6	PE-V0-412-155-I906	I/O LIST (ANALOG & BINARY)	A
7	PE-V0-412-155-I907	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
8	PE-V0-412-155-I908	DATASHEETS FOR INSTRUMENTS, JBs,Analysers etc.along with catalogue	A
9	PE-V0-412-155-I909	INSTRUMENT HOOK-UP DRAWING	A
10	PE-V0-412-155-I910	QUALITY PLANS/CHECK LISTS (For all applicable instruments)	A
11	PE-V0-412-155-I911	CABLE SCHEDULE & INTERCONNECTION	I
12	PE-V0-412-155-I912	ANNUNCIATION & SOE LIST	A
NOTES: 1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION. 2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.			

ACTUATORS

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-DG-412-145-I902	
			VOLUME II B	
			SECTION D	
			REV. NO. 02	DATE: 28.03.17
			SHEET 2	4
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL*	* PROJECT	2x 660 MW ENNORE SUPERCRITICAL TPP		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	☐ ON / OFF	☐ INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:68		
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL		
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.		
HANDWHEEL	* REQUIRED	☒ YES ☐ NO		
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED		
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- INCLUSIVE OF I.S. TOLERANCE		
	ACTUATOR APPLICABLE WIRING DIAGRAM	☐ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram		
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐		
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☒ EPOXY ☐		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V		

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			VOLUME II B	
			SECTION D	
			REV. NO. 02	DATE: 28.03.17
		SHEET 3	:	4
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	@ ENCLOSURE CLASS OF MOTOR	☒ IP 68 ☐ FLAME PROOF		
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B		
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☐ -----		
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED		
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED		
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS		
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)		
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED		
	OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED		
	STOP PB	☒ REQUIRED ☐ NOT REQUIRED		
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED		
	LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED		
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED		
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (MOTOR THERMOSTAT TRIP, O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, PHASE LOSS, S/S IN LOCAL or OFF MODE, STOP PB OPTD, TORQUE OPEN/CLOSE CUTOFF)		
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER		
	QUANTITY	☒ 2 NOs. ☐ 3 Nos. *		
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC		
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX		
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms		
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos		
	CONTACT TYPE	2 NO + 2 NC		
	RATING	5A 240V AC AND 0.5A 220V DC		
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE		
	ACCURACY	+3% OF SET VALUE		
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN : INT : CLOSE	☐ 1 No ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		

*For inching type drives IPR 3 Nos. to be considered for inching operation.





SPECIFICATION FOR MOTORISED VALVE ACTUATOR

SPECIFICATION NO.: PE-DG-412-145-I902

VOLUME II B

SECTION D

REV. NO.

02

DATE: 28.03.17

SHEET

4

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4

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

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

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☒ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☒ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	☒ 24V DC ☐	
	OUTPUT	☒ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz	
	@ POWER SUPPLY (INTEGRAL) BI	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☒ IP 68 @ ☐	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☒ NOT REQUIRED ☐ ☐ 2 NOS. ☐	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: suitable for 3Cx2.5sq mm Cu	
	@ SPACE HEATER CABLE GLAND	SIZE:-	
	OTHER CONTROL CABLE GLANDS	QUANTITY & SIZE: Cable gland suitable for 8Px0.5 sq mm & 2P x 0.5 sq mm cable.	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

- SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
- CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
- ACTUATOR SHALL HAVE HARDWIRED CONTACTS FOR FOLLOWING SIGNALS (a) ACTUATOR IN LOCAL MODE (b) ACTUATOR IN REMOTE MODE
- BIDDER TO ENSURE AVAILABILITY OF SPARE 1NO + 1NC LIMIT SWITCH & TORQUE SWITCH.
- SS TAG NAME PLATE SHALL BE PROVIDED.
- TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
- CABLE GLANDS OF DOUBLE COMPRESSION TYPE, Ni PLATED BRASS MATERIAL SHALL BE PROVIDED.
- THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
- THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
- THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
- LOCAL DIGITAL POSITION INDICATOR SHALL BE PROVIDED FOR INCHING DUTY DRIVES.
- COMMANDS SHALL BE LATCHED AT INTEGRAL STARTER END.
- SWITCHES SHALL BE TERMINATED IN JB MOUNTED ON ACTUATOR.
- ACTUATORS FOR HAZARDOUS AREA SHALL BE CERTIFIED FLAME PROOF FOR ZONES 1 & 2.

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

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

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

FIELD & MEASURING INSTRUMENTS

CHAPTER-3**FIELD AND MEASURING INSTRUMENTS****3.00.00 FIELD & MEASURING INSTRUMENTS (PRIMARY & SECONDARY INSTRUMENTS)****3.01.00 GENERAL REQUIREMENTS**

3.01.01 Instruments, control devices and other equipment accessories covered under this specification shall be furnished in accordance with I&C specification sheets and drawings enclosed herewith and the requirements of all applicable clauses of this specification.

3.01.03 The instrumentation/control equipment and accessories shall be from the latest proven design for which the performance and high availability have been demonstrated by a considerable record of successful operation in power station service for similar applications. The bidder shall furnish sufficient evidence to fully satisfy the Owner in this regard.

3.01.04 For plug in type instruments, The plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections. Signal/Electrical connection shall be screwed connection with double compression type Nickel-plated brass cable glands for Explosion proof area, Flame proof area and high vibration prone area.

3.01.05 Every instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuse of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

3.01.06 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1, Division 1 area & flame proof) and an anti corrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange shall also be included wherever required with the field instruments.

3.02.00 Following minimum requirement of field instruments shall be fulfilled by Bidder (In addition, Redundancy criteria for field instruments shall be as specified else where in specification): -



- iii. Level Transmitters (Type as per Owner approval) for open sump/tank/bunker/vessel/heaters.
- iv. Stand pipes on both side of tank for all level instruments (LT, LS & LG).
- v. Flow elements with flow transmitter & Flow meter for flow measurement of as decided by owner
- vi. Pressure gauges and temp. Gauges at inlet and outlet of each heat exchanger and cooler.
- vii. DPG, DPT & DPS across the filters/strainers.
- viii. Tapping points/test points shall be provided.
- x. All Thermocouples & RTDs shall be Duplex.
- xi. All Field Instruments used in acid or alkaline atmosphere shall be with standard Anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).
- xii. All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.
- xiii. Transmitters (all type) for monitoring & controls purpose.



- xvii All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.
- xviii All limit switch shall be conform to IEC-60947-5-1.
- xxi. Temp. Transmitters are envisaged with RTD & Thermocouples for monitoring services/application only. However any RTD & Thermocouples are used for control, interlock & protection application, same shall be directly wired to DDCMIS/DCS/PLC using instrumentation & Extension cables respectively.
- xxiii. Contacts less, electronic 2-wire position transmitters shall be provided for all inching type motorised valve and dampers.
- xxvii. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. For HFO, LFO Applications, SS capillary with thin wafer element with ANSI RF flanged ends are to be provided. For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided.

FIELD INSTRUMENTS SHALL BE SUPPLIED & OFFERED AS PER DATA SHEETS SPECIFIED BELOW:



2 x 660 MW ENNORE SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14



3.03.00 TRANSMITTERS, SWITCHES, GAUGES AND PANEL MOUNTED INSTRUMENTS**3.03.01 Pressure, Differential Pressure, DP type Level and Flow Transmitters (PT, DPT, LT & FT)**

Smart Transmitters of the electronic type shall be furnished.

Transmitters shall be equipped with mounting brackets suitable for a mounting in transmitter enclosures.

In general, Transmitters are envisaged to be grouped at several places as to be decided during detailed engg. stage. For this purpose, suitable enclosures complete with all tubing, fittings, purge meters, loop cable trays etc. shall be provided.

Type/Construction	:	Sealed capacitance/ Inductance/ Silicon resonance type
Material		
- Body	:	Die cast Aluminum with epoxy coating for air & flue gas SS316 for other services
- Diaphragm	:	316 SS
- Measurement element	:	Teflon seal
- Valves	:	Carbon steel for non-corrosive Applications SS316 for corrosive applications.
Output signal	:	4 to 20 m Amp. DC (Two wires) HART Compatible
Local Indicator	:	LCD indicator (5 digit) with scale of Engg. unit
Overall Accuracy	:	$\pm 0.04\%$ or better of Span for BTG package $\pm 0.065\%$ or better of Span for BOP packages $\pm 0.2\%$ or better of span for remote seal type transmitter.
Turn down ratio	:	100:1 in general
Stability	:	$\pm 0.15\%$ of URL for 5 years.
Response time	:	150 msec.
Power supply	:	24V DC nominal
Drive capability	:	600 Ohms nominal
Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Span and Zero	:	Locally adjustable, non-interacting



Zero suppression / elevation : At least 100% of Span

Connection

- Process : 1. Half (1/2) inch NPT (F)
Quarter (1/4) inch NPT
with/without oval flanges

- Electrical : Suitable for Plug in type connection (Both side of transmitter), unused entry with blind plug.

Accessories

- For Absolute Pressure Transmitters: Two (2) valve SS316 manifold

- For Gauge & Vacuum pressure transmitter : Three (3) valve SS316 manifold

- For DP, level & flow transmitter : Five (5) valve SS316 manifold

- For oil and corrosive liquids : Separator diaphragm seals

- For all transmitters : Mounting bracket

Manifold should not be mounted on the transmitter, Manifold shall be non integral and standalone type. Snubbers/Pulsation dampners shall be used where the process media is unstable for measurement such as the discharge of a pump. Over range protection shall be used where necessary. The coil syphons & condensate pots shall be used for steam services. Transmitters shall be provided with suitable drain & vent points.

3.03.02 PRESSURE SWITCHES (PS) & DIFFERENTIAL PRESSURE SWITCHES (DPS)

Applicable Standards : IS3624 - 1966/ISA-RP-8.1 except as modified in spec.

Type/Construction : Bourdon/Sealed Diaphragm Piston
Actuated preferable. Indicators with contacts are not acceptable.

Materials

- Bellows : 316 SS

- Bourdon tube : 316 SS

- Movement : 316 SS

- Encloser : Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.

- Protective Diaphragm : Teflon



Accuracy	:	$\pm$ One (1) percent or better
Repeatability	:	$\pm$ 0.5(half) percent or better
Setting & Differential	:	Adjustable
Contact		
- Number	:	DPDT /2 SPDT
- Type	:	Auto reset with internal Adjustable snap action micro switch
- Rating	:	5 Amp, 240V AC / 0.2 Amp, 220V DC
Connection - instrument	:	Half (1/2) inch NPT Male Process
Electrical	:	Suitable for Plug in type connection. All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
- Over range protection	:	One Fifty (150) percent of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
Accessories		
- 3 / 5 valve manifold	:	As applicable for all switches
- Self cleaning type pulsation dampners/Snubber (Material SS316)	:	Pump and compressor discharge lines
- Syphon	:	For all steam lines
- Protective separating diaphragm	:	For fuel oil & corrosive liquid lines.
Mounting	:	Local (in LIE/LIR for BTG package).

3.03.03 PRESSURE & DIFFERENTIAL PRESSURE GAUGES (PG & DPG)

Applicable standard	:	IS:3602-1966, IS/3624, ASME B 40.1
Type/Construction	:	
-760 mm to 1.0Kg/cm ²	:	Bellows/Diaphragm
-Above1.0Kg/cm ²	:	Bourdon Tube
- Suction side of pumps	:	Compound gauge
Materials		
- Bourdon tube	:	316 SS
- Bellows	:	316 SS
- Movement	:	316 SS
- Case	:	SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating



		shall be provided for corrosive atmosphere.
- Protective Diaphragm	:	Teflon
Dial size	:	150mm with shatter proof glass
Scale Details	:	Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.
Accuracy	:	$\pm$ One (1) percent or better
Connection - Instrument Process	:	1/2 inch NPT Male Bottom
Mounting	:	Local
	:	1/2 inch NPT Male (Back entry) mounted on local gauge board.
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

Accessories

- 3 way needle valve/manifolds	:	For all gauges
- Self cleaning type	:	Pump and compressor discharge lines
Pulsation dampener/snubber (S316)	:	
- Syphon	:	For all steam lines
- Protective separating	:	For fuel oil and corrosive liquid lines

Other particulars

- External Zero adjustment	:	For all gauges
- Safety device	:	
Ranges 5 to 20 Kg/cm ²	:	Rubber blow out disc with open front construction.
Ranges above 20 Kg/cm ²	:	Neoprene safety diaphragm at the back with solid front construction.
- Over range protection	:	One Fifty (150) percent of full scale

Other Requirments

	:	Movement mechanism shall be glycerin filled for oil services & vibration prone area.
	:	For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armored capillary of 10 M for Fuel oil & Corrosive liquid service.



- : Contact type pressure gauges are not acceptable for interlock & protection.
- : For condensate storage tank the pressure gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300mm or bigger size** shall be provided.

3.03.04 TEMPERATURE TRANSMITTERS

Type	:	SMART type configurable from control room through HART protocol (HMS System).
Display type	:	Indicating type (5 digit LCD Display),
Accuracy	:	$\pm 0.10\%$,
Ambient temperature error	:	0.1% per 10°C change
Output	:	4-20 mA DC (2 wire system) HART compatible signals for analogue monitoring inputs to the distributed control system (DDCMIS), DCS & PLC.
Protection class	:	NEMA 4/IP66 or equivalent degree of protection for enclosure/ (Explosion/Flame proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Material of accessories	:	SS316.
Stability	:	$\pm 0.1\%$ or ± 0.1 deg C of reading (whichever is great) for 2 years in case of RTD inputs and for 1 year in case of Thermocouples inputs.
Operating Voltage	:	16 – 48 V DC
Calibration	:	as per NIST monograph 125 for T/C & European Curve Alpha = 0.00385 for RTD .
Ref. Junction compensation	:	Provided
Span/zero adjustment	:	Locally adjustable, Non interacting
Auto calibration	:	Provided
Burn out protection upscale	:	Provided
Input - output isolation	:	Provided
Circuit ungrounded	:	Provided

Any RTD & Thermocouples shall be directly wired to DDCMIS/DCS/PLC for metal temperature application, bearing & winding temp application only.

The Temperature transmitter shall accept Universal dual inputs of all types of thermocouples & RTD, 0-5V input signals etc.



Temp. Transmitter shall be extremely stable against Ambient temp variation, The accuracy figure shall be inclusive of effect due to ambient temperature variation

3.03.05 RESISTANCE TEMPERATURE SENSORS WITH THERMOWELLS

Applicable Standard	:	ASME PTC 19.3 - Latest Revision DIN EN 60751:1996, BS EN/IEC60751:2008
Element	:	Platinum, R0=100 ohm 4-wire Duplex for Process Temp. Measurement Platinum, R0=100 ohm 3-wire Duplex for Bearing & Winding Temp. Measurement
Sheath Material/ Insulation	:	316SS/Compacted Magnesium Oxide
Sheath O D	:	8 MM
- Gauge	:	18 AWG
Terminals	:	Spring loaded high temperature ceramic base with silver plated brass for high vibrating locations.
Calibration	:	As per DIN Standard – 43760, Class A
Head	:	Hex Head, Die Cast Aluminum (Screwed) with galvanized SS chain
Response Time	:	6-10 Sec bare & 30 Sec. With protective sheath/thermowell
Accuracy	:	± 0.35 degree C or Class-A whichever is better.
Electrical connection	:	Gold plated Plug in type. Double entry – one unused entry with blind plug
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

THERMOWELL

Applicable Standard	:	ASME PTC 19.3 TW - 2010
- Construction	:	Tapered drilled from Bar stock (Straight for Air & Gas systems)
- Material	:	- 316 SS/F11/F22/F91 - water and steam Services depending upon process parameters. - Inconel for air & flue gas services For furnace zone, impervious ceramic protecting tube of suitable material along



with Incoloy supporting tubes and adjustable flanges.

For Mill classifier outlet long life solid sintered tungsten carbide material or better of high abrasion resistance.

Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 2010. "All Thermowells in high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safer size and design of Thermowells".

- Process Connection	:	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
- Extension	:	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
Immersion length	:	Within ± 10 mm of center line of pipe and as per ASME – PTC-19.3 - 2010
Extension neck length	:	Minimum 100 mm above insulation of pipe and Minimum 160 mm when there is no insulation on pipe.
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations
Note	:	Extension /Compensating/paired cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

~~3.03.06 THERMOCOUPLES WITH THERMOWELLS~~

Applicable standard	:	ASME PTC 19.3- Latest Revision ANSI-MC 96.1 – 1982, IEC 584-2
Element	:	Duplex
- Sheath	:	8 MM OD
- Sheath Material	:	316 SS
- Spring Loaded	:	Yes
- Nipple/Union	:	Yes
- Packed connector	:	Compacted magnesium Oxide ungrounded



with two nipples of SS 316 having 1/2"NPT(M) threads at both ends

Thermowell : To suit Temp. switch with same design criteria as specified for RTDs.
Electrical : Suitable for Plug in type.

All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.

Other Particulars

- Capillary length : As per requirement (min 10 meters)
- Immersion Length : Within + ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length : Minimum 50 mm above insulation of pipe /As per approved hookup drawings.
- Packing glands : Yes
IBR Certification : For high pressure service, Steam Temp, Fuel oil temp. measurement as per IBR rules and regulations
N.B : Switches designed for cross ambient operation shall be used in applications where the ambient temperature will approximate or exceed the switch set point.

3.03.09 TEMPERATURE GAUGES (TG)

Applicable standard : IS : 3602,BS:5235 ISA:RP:8.1 except as modified in this specification

Type/Construction

- Thermometer : Industrial type, Gas in Filled type with separable thermowell
- Thermowell : Bar stock

Material

- Bulb : 316 SS
- Capillary : Armoured SS (Applicable for capillary Type)
- Casing : SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating



		shall be provided for corrosive atmosphere
Dial Size	:	150mm with shatter proof glass
Scale Details	:	270 degree dial rotation/deflection. Graduations in black lines on white dial provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller .Pointer stop for all gauges
Accuracy	:	$\pm$ One (1) percent or better
Response time	:	Maximum 15 seconds without thermowell and 30 seconds with thermowell
Connection		
- Pipe	:	M33 x 2
- Thermowell	:	To suit instrument with same design criteria specified for RTDs.
- Process Connection	:	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
- Extension	:	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
Other Particulars		
- Capillary length	:	5Meters/10 Meters as required
- Immersion Length	:	Within + ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length	:	Minimum 50 mm above insulation of pipe /As per approved hookup drawings.
- Stop at Maximum value	:	For all gauges of scale
- Pointer	:	Externally adjustable
	:	In general, Contact type Temp. gauges are not acceptable for interlock & protection.
		Contact type Temp. gauges are acceptable for interlock & protection in case of bearing temp. only.
- Over range protection	:	150 percent (%) of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
IBR Certification	:	For high pressure service, Steam



Temp., Fuel oil temp. measurement
as per IBR rules and regulations

3.03.10 TEST THERMOWELLS (TW)

Applicable Standard	:	ASME PTC 19.3 TW - 2010
Type/Construction	:	Machined from Bar Stock
Material	:	316 SS/F11/F22/F91
Connection	:	
- Pipe	:	M33 x 2
- Test Instrument	:	To suit test instruments
Accessories	:	Plug with chain
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations Bidder shall provide calculation for thermowell as per ASME – PTC- 19.3 TW - 2010.

Test wells shall be provided on main steam, reheat steam, extraction steam, feed water, condensate, spray water lines and other piping as required to meet ASME test requirements.

3.03.11 DIRECT MOUNTED LEVEL TRANSMITTERS (LT)

Displacer type level transmitter shall not be used in the process anywhere in the plant.

3.03.12 Ultrasonic Level Transmitter (for Water sump/Tank level, Raw water reservoir level, Cooling water fore bay level measurements)

Principle of Operation	:	Detection of reflected ultrasonic pulse
Measuring Ranges	:	Up to 30 meters (typical)
Signal Processing	:	Microprocessor Controlled Signal Processing
Operating Freq.	:	10 KHz to 50 KHz (typical)
Display	:	Head mounted alpha-numeric back lit LCD/LED
Calibration & Configuration	:	Accessible from front of panel & HART calibrator.
Diagnosis	:	On-line
Status	:	For power, Hi / Lo / V. Hi / V. Lo- level indication, fault etc.
Construction	:	Plug-on board
Power supply	:	240 V AC 50 Hz / 24V DC
Signal Output	:	4-20 mA DC with HART (isolated) - 600 Ohm load.
Hysteresis	:	Fully adjustable preferred
Output contacts	:	2SPDT Potential free changeover contacts @ 8A 230V AC.
Accuracy & Repeatability	:	± 0.25% of span or better
Resolution	:	± 0.1% of span
Temperature Compensation: To be provided with Transducer.		



Operating temp.	:	Transmitter-50 deg C and Sensor – 80 deg C
MOC Sensor	:	Body- PVDF and Face – Polyurethane
Humidity	:	1% to 95% non condensing.
Enclosure	:	IP-67 Epoxy painted die cast Aluminum or SS316L housing.
Cable Connection	:	3/4" ET
Mounting	:	2" – 4" NPT or flanged
Accessories	:	Cable gland, prefab cable, mounting accessories like EPDM seal, SS316 flanged etc.
		Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during detailed engineering.

3.03.13 CAPACITANCE TYPE LEVEL TRANSMITTER

The total system shall consist of capacitance probe, pre-amplifier and transmitter

Type	:	Capacitance type
Probe	:	a) Rod or suspended electrode. b) Rope type probes may be used only where required probe length is greater than 3 meters
Probe Mounting	:	Stainless steel 1-1/2 ANSI RF Flange / ¾" NPT (M)
Material of construction	:	316 SS
Insulation	:	PTFE Part/Full as per service.
Transmitter	:	The transmitter shall receive output of the preamplifier and convert it into 4-20 mA DC output signal.
Accuracy	:	± 1% of Full scale
Repeatability	:	± 0.5 % of Full scale
Load	:	Min 600 Ohms
Enclosure	:	Powder/Epoxy coated Die cast aluminum. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
Ambient temperature	:	0-60 °C.
Mounting	:	Wall / Surface
Supply voltage	:	240V AC, 50Hz / 24V DC
Response time	:	100 m sec or better
Cable connection	:	¾" ET
Accessories	:	Counter flange, Cable gland, prefab cable if any
Preferable features	:	Alarm output contacts with adjustable set point facility

3.03.14 GUIDED WAVE RADAR/RADAR LEVEL TRANSMITTER

Type	:	Guided wave Radar (Contact type)/Radar (Non contact type) as finalized by owner.
Application	:	For Turbine Lube oil tank, HFO & LDO tank level,



		Condenser Hotwell, LP heaters, CBD tank level, Stator water expansion level, and other Low pressure, Vacuum vessels.
Environment Class	:	Highly abrasive with Gases and Fumes
Orientation	:	Vertical
Probe Type	:	Flexible Single lead with chuck
Probe Material	:	SS 316L
Connection Size & Type	:	2" Flanged ANSI 300 lb SS316L material
Connection material	:	SS 316L
Accuracy	:	+/- 5 mm
Resolution	:	± 1 mm
Type (Transmitter)	:	SMART, 2 Wire
Operating Principle	:	Time Domain Reflectometry
Output	:	4-20 mA, DC with HART protocol and 600 Ω output load.
Electrical Connection	:	1/2" NPT
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
Electrical Power	:	11-42 V DC
Housing material	:	Die Cast Aluminum
Vent & Drain Plug material	:	SS
Side Flange Material	:	SS
Local Display	:	Provided (LCD Digital)
Units of Measurement	:	Length M
Electromagnetic compatibility:	:	EN-61326

3.03.15 3 D TYPE ACOUSTIC WAVE LEVEL TRANSMITTER

Type	:	Acoustic Wave Level Transmitter (3 D type)
Application	:	Coal and Ash Bunker Level, Volume & Mass.
Temperature compensation	:	Required for high temp applications
Operating Principle	:	Non - Intrusive acoustic wave transmission & Reflection
Frequency Range	:	3 – 10 KHz
Accuracy	:	+/- 0.25 % for even surface & $\pm$ 0.5% for uneven surface.
Resolution	:	1 mm
Output	:	4-20mA DC with HART
Display Unit:		
Type	:	Head mounted LCD Display with Engg. Units
Location	:	Suitable location at bunker / Silo operating floor area
Protection Class	:	IP 65 or better// flame proof (IEC-79.1, Part I) As applicable).
Material Of construction:		



~~D. Application : Ash Silos~~

3.03.18

LEVEL INDICATORS (Gauge Glass) (LI)

Type/Construction	:	a) Reflex b) Tubular (For tanks open to atmosphere only)
Material:		
a) Glass	:	Tempered borosilicate resistant to thermal shock
b) Case	:	Carbon steel
c) Integral cocks and	:	i) Forged carbon steel with drain valves stainless steel internals ii) Rubber lined corrosion resistant 316 stainless steel (for Demineralised and Osmosis water service)
d) Fittings	:	i) Forged carbon steel ii) Rubber lined 316 steel/PVC for corrosive liquids Demineralised and Osmosis water service) iii) 304 Stainless Steel for non-corrosive liquids
e) Packing	:	Teflon
Dial size/scale	:	150 mm /1.5 Meters maximum length with
Scale details	:	Aluminum/SS316 scale Graduated in mmwc
Connection	:	25 Nb/40 Nb ANSI Flanged
Accessories	:	a) Integral cocks b) Drain valves c) Bolts, nuts and gaskets d) Illuminating lamps as required e) Periscope as required
Tests	:	Tested at two hundred (200) percent of the maximum process pressure
Other details	:	For larger lengths, additional gauge glasses shall be provided with minimum of 50 mm overlap.

3.03.19

FLOAT & BOARD TYPE LEVEL GAUGE

Type of Instrument	:	Mechanical Type (Float Operated)
Service/ Application	:	As per service requirement
Measuring Range	:	as per requirement
Material Specification		
a) Float Material	:	SS316 having 2 nos. Guide wires
b) Float Wire Pulley	:	Shall comprise of 2 nos. Cast Aluminum Pulley hosing Assembly with SS 304 pulley and pulley shaft. Steel ball bearings shall be provided in pulley housing for easier float movement. Float wire material shall be



SS316L. Between 2 pulleys, 1" NB G.I. short pipe with tentative length as per P&ID

- | | | |
|--|---|--|
| c) Guide wire Assembly | : | CS chamber with spring and adjuster having 1" Class 150 ANSI RF MS flange. Guide wire rope shall be SS316L. |
| d) Counter Weight | : | MS counter – weight with Aluminum Pointer and Brass assembly Pull Chain. |
| e) Scale | : | SS 316/Aluminum material in mm with 1 % accuracy. |
| Nozzle Details | : | For float wire pulley assembly, one tapping and for guide wire assembly two tapping at the top of the tank; Size 1" NB (Top Mounting Type) |
| Process Connection | : | Flanged as per ANSI B 16.5 to suit 1" NB nozzle (Nozzle length - 150 mm for float wire, 100 mm for guide wire) |
| Accessories (to be supplied with the instrument) | | |
| a) Counter flange | : | All mating Flanges, Nozzle |
| b) Mounting Accessories | : | All mounting accessories |
| c) Tag Plate | : | To be provided (material SS316) |

3.03.20**MASS FLOW METER****Sensor**

- | | | |
|---------------------------------|---|--|
| Measuring Principle | : | Coriolis Mass flow. |
| Primary Element | : | Flow Tube of 316SS or better |
| Heating Arrangement | : | Integral with Flow meter. |
| Temperature Control For Heating | : | To be provided. |
| Process Connection | : | ANSI RF Flanged and rating as per process requirement. |
| Drain | : | Self-draining facility |
| Accessories | : | Counter flanges, Mounting nuts, bolts, gaskets etc. |

Transmitter

- | | | |
|-------------------------|---|---|
| Measured quantities | : | Mass Flow rate, Total Mass Flow, Density, Temperature as minimum. |
| Input Signal Processing | : | Digital Processing. |
| Display | : | Digital Display (LCD). |
| Output | : | 2 Nos. isolated output of 4-20mA DC selectable from four measured quantities. |
| Load | : | < 750 ohms. |
| Power supply | : | 240V AC, 50 Hz. From UPS |
| Accuracy | : | 0.15% of measured value for Liquid
0.5% of measured value for Gas |
| Repeatability | : | 0.05% |
| Housing | : | IP 65 (Explosion proof for NEC Class-1, Division 1 area) |
| Hazardous duty Version | : | FM Standards. |



Output Signal	:	Pulse
Material of Construction	:	AISI 316
Sensor Seal	:	PTFE / higher based on temperature
Flow range	:	As required.
Linearity	:	0.25% or better.
Repeatability	:	0.02% or better.
Ambient temperature	:	50 deg C
Mounting	:	On-Line mounting with flanges of stainless steel.
Enclosure	:	IP 65
Accessories	:	Nuts, bolts, gaskets etc.
Transmitter		
Electronics	:	Solid State
Power Supply	:	240V AC, 50Hz. UPS
Input	:	Input from Sensor
Display	:	4 1/2 digit LCD
Output	:	Isolated 4-20mA DC HART
Measuring Accuracy	:	0.5% of full scale range
Totalized Value	:	Required
Housing	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	Clamping strip, bracket, prefab cable etc. Special tool kit for calibration/ configuration .

3.03.23 Flow Transmitter (Ultrasonic)

Type	:	ULTRA SONIC, 2-wired
Sensing element	:	Non-contact
Output	:	4-20mA with HART Protocol
Accuracy	:	± 0.1% FS
Supply	:	24 V DC
Enclosure class	:	IP-65
Transmitter		
Mounting	:	On Nozzle
Mounting position	:	Top mounted
Housing	:	Plastic
Display	:	Head mounted LCD Display and remote LCD display
Process connection	:	NPT/Flanged
Electrical connection :	:	NPT
Turn Down ratio	:	1:100
Measuring range	:	Adjustable (as per process requirement)
Totaliser	:	Required
Accessories	:	As per process requirement Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during



- b) Nuts, bolts, gaskets, mesh etc.
Special tool kit for calibration/configuration.

3.03.25 Electromagnetic Flow meter

Electromagnetic flow meters shall have separate transmitter having accuracy $\pm 0.2\%$ with zero stability feature, suitable for process medium with ≤ 5 micron Siemens conductivity, flanges material SS-316, electrode & measuring tube material SS-316, liner material Teflon and enclosure IP-66, local digital display configurable as totaliser, 4-20 mA output signal HART compatible with zero and span field adjustable. Application – DM Water and for other application as decided by owner.

3.03.26 FLOW GAUGES (FG)

- | | | |
|-------------------|---|---|
| Type/Construction | : | a) On-line type Rotameter for 50 Nb and below lines |
| | : | b) Bypass type Rotameter for above 50 Nb lines. |

Material

- For On-line type

- | | | |
|---------------|---|--------------------|
| Metering Tube | : | Borosilicate glass |
| Float | : | 316 SS |
| Packing | : | Teflon |
| End fittings | : | 304 SS |

-For Bypass type

- | | | |
|--------------------------|---|---|
| Metering Tube | : | Borosilicate glass |
| Float | : | 316 SS |
| Packing | : | Teflon |
| End Fittings | : | 304 SS |
| Orifice Plate | : | 316 SS |
| Carrier ring | : | 304 SS |
| Flanges & Mating flanges | : | Same as pipe material, 200 lbs ANSI - RF |
| Impulse pipe | : | Same as pipe material |
| Fittings | : | 2000 ANSI, SW ends to match with pipe material. |
| Dial Size/Scale length | : | 250 mm |
| Scale Details | : | Direct reading type engraved on detachable Aluminum scale |
| Accuracy | : | $\pm$ Two (2) percent |
| Reproducibility | : | Half (1/2) percent |
| Rangeability | : | 1:10 |
| Connection | : | SCRD NPT |



Accessories	:	a) Isolating valves (for Bypass type only)
		b) Bolts, Nuts and Gaskets as required
Tests	:	Shall be tested at two hundred (200) percent of the maximum process pressure

3.03.27 SIGHT FLOW GLASS INDICATORS

Type/Construction	:	Flapper type.
Materials	:	
Body	:	Carbon steel/SS316 as per process requirement
Glass	:	Toughened Borosilicate
Gaskets	:	Neoprene
Bolts & nuts	:	SS
Flappers / Rotating Wheel	:	316 SS
Flappers / Rotating Wheel holder	:	304 SS
Process Connection	:	SW (Socket Welded)
Accessories	:	Scale, Bolts, Nuts, Cover plates and Gaskets as required
Tests	:	Tested at two hundred (200) percent of the maximum process pressure.

3.03.28 SOLID FLOWMETER

Type	:	Online Impact type Microprocessor Based
Measuring Principle	:	The system measurement is basically pertains to the measurement of horizontal deflection using LVDT, created by the impact of solid flow upon online sensing plate. The horizontal deflection being proportional to the impact forces, LVDT convert this horizontal movement into electrical signal. The inbuilt integrator convert this signal into time based flow rate indication & provide totalized flow also.
Sensing plate	:	316 SS
Sensing head	:	Sensing mechanism shall be mounted outside the process flow line.
Enclosure	:	316 SS
Enclosure protection	:	IP 67 class
Accuracy	:	+/-1%
Repeatability	:	+/- 0.2%
Drift	:	Both zero & span $\pm$ 2% / month
Output	:	4-20mA DC isolated, load 600 ohm (min)
Digital communication	:	yes, (HART) facility
Power supply	:	240 V AC, 50Hz. UPS
Ambient condition	:	Temperature -60 ^o C, RH-95% Environment – Highly Dusty



Accessories : Shall be complete with all the accessories including digital display for flow rate, integral vents, baffles for air separation, etc. which ever required for satisfactory operation.

Note:-

1. The above on line flow meter shall not create any obstruction on flow.
2. User's list shall be submitted to support on proven satisfactory performance for similar process application.

3.03.29

Instrument Air System

The instrument Air Supply System for various pneumatic Control & Instrumentation devices like pneumatic actuators, power cylinders, I/P converters, pneumatically operated valves etc. shall be complete in all respect with necessary Air Filter Regulators, valves, piping/tubing etc.. Each pneumatic instrument shall have an individual air shut off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built in filter-housing blow down valve.

Filter shall be of minimum 5-micron size & sintered bronze material.

On collection of water in the drains of instrument air lines, mechanical automatic drains and periodically solenoid operated drains (with electronic timer - 15m, 30m, 60m and 2 Hours & Timing adjustable) are to be provided.

For mechanical type & Electrical type, the locations to be provided in the instrument air lines of boiler area, Chimney area, turbine area etc., shall be decided during detailed Engineering.

Bulk header nearby the crowded applications shall be provided and from this bulk header individual air lines with necessary isolation valves are laid to the application.

These bulk header are to be provided with **mechanical / electronic based automatic Drains**.

Individual moisture separator for O₂ analyzer or vital application shall be provided nearby the instrument so as to enhance the cell life or the performance of vital final control elements.

3.03.30

Air Filter Regulator (AFR)

Constant bleed type AFR with an accuracy of ± 1.0 % inlet pressure range of 5-8 kg/ cm² and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E/P converters and shut off valves for phosphor bronze filter element; Filtering particles above five microns. Weather and water proof enclosure. Material of accessories will be SS316.

Air filter regulators shall be provided in the :

- (a) Air supply line to valve positioners / power cylinders
- (b) Air supply line to electric to pneumatic converters.



- (c) Air supply line to pneumatic interlocked block valves.
- (d) For each instrument rack, field instruments enclosure for purging.

3.03.31 Electro-Pneumatic Convertors (E/P)

Two wire type E/P convertors with an accuracy of $\pm 0.25\%$ accepting 4-20 mA dc signals from control system and converting to 0.2 to 1 kg/cm² air pressure to operate valve positioner of all final control elements; Housed in cast aluminum casing (with polyurethane paint); NEMA 4 or equivalent degree of protection for enclosure. Material of accessories will be SS. E/P convertors shall have fail freeze (stay put) feature also. Process connection shall be 1/4" NPT (F) and Electrical connection shall be 1/2" NPT (F). Zero/span adjustment facility shall be provided. The E to P convertors shall **retain the pneumatic signal (last value) even in failure of control signal** and shall have **self volume boosters**. Necessary air lock devices and pressure switches for air pressure low alarming shall be provided.

3.03.32 Solenoid Valves

Solenoid valves shall be provided with control valves / pneumatic control valves hooked up with process interlock requirements and where direct tripping is involved. The number of ways for solenoid valve shall be provided as indicated below:

- (a) Two (2) way solenoid valves shall be provided, where process line of less than 50 mm with low pressure and temperature application.
- (b) Three (3) way solenoid valve shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder, e.g, Pneumatic operated spray water block valve.
- (c) Four (4) way solenoid valve shall be provided for operating double acting cylinders, e.g, Pneumatically operated on-off type dampers.
- (d) For operation of the fuel oil corner nozzle valves, fuel oil trip valves etc., **double coil solenoid valve** (latch coil & relatch coil) shall be adopted.
Single coil usage requires always power and loss of power leads to closure of above valves resulting the unit trip or loss of generation.
- (e) Solenoid Valve coils shall be Class-H high-temperature or Class-F construction as applicable and shall be designed for continuous duty. Three-way solenoid valves shall be designed for universal operation so that the supply air may be connected to any port. Solenoid enclosures shall be NEMA-4)/ (Explosion proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I) As applicable). Body material of solenoid valve shall be Die Cast Aluminum or SS316.
- (f) All solenoid shall be with varister, LED indication, surge suppress diode and circuits.

3.03.33 Power Cylinders (Pneumatic)

Mounting Type	:	a) Fixed position mounting (End mounting).
	:	b) Trunnion mounting
Control Signal	:	0.2 to 1 Kg/Sq. cm. from I/P converter for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line.



		The Pilot solenoid will have separate coils for open closing purpose.
Supply Air	:	0-7 Kg / Cm ² .
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.
Casing	:	IP-65.
Accessories (as required)	:	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Positioner with Input, Output and supply pressure gauges. g) Pilot Solenoid Valve (Double Coil type) h) Position Transmitter (4-20 mA DC linear output, LVDT or non contact type).
Fail-safe operation	:	Stay put, open or close position on pneumatic / electrical power supply failure as per process safety criteria.
Repeatability	:	Better than 0.5% of full travel.
Hysteresis	:	Less than 1% of full travel.

3.03.34 Nucleonic Type Density Meter (For Ash Handling Plant):-

Type	:	Nuclear type radiation
Application	:	Abrasive Slurries & Corrosive Chemicals
Accuracy	:	< 1% of Span
Orientation	:	As per requirement.
System Type	:	Radiation Source & Scintillation Detector
Meter Material	:	SS 316L/ Aluminium with PVC coating
Connection material	:	SS 316L
Compensation	:	Temp. Compensation required
Type (Transmitter)	:	SMART, 2 Wire HART based
Operating Principle	:	As the density increase, the lower the radiation field at detector and vice versa
Output	:	With photomultiplier, 4-20 mA, DC
Electrical Connection	:	½" NPT
Enclosure Class	:	IP 66
Local Display	:	Provided
Accessories	:	Radiation Survey Meter and all erection/installation hardware

3.03.35 Non - Nucleonic (Vibration) Type Density Meter (For DM & AHP Plant):-

Application	:	Liquid Density measurement
Detector	:	



- | | | | |
|----|----------------------|---|-------------------------------|
| 1. | Orientation | : | As per requirement. |
| 2. | Case Material | : | SS 316/ Cast Aluminium alloy |
| 3. | Wetted part material | : | SS 316 |
| 4. | Operating Principle | : | Vibration Density measurement |

Convertor

- | | | | |
|----|-----------------------|---|---|
| 1. | Output | : | 4-20 mA DC isolated. |
| 2. | Electrical Connection | : | ½" NPT |
| 3. | Enclosure Class | : | IP 65 |
| 4. | Local Display | : | Digital 5 digit, density display with temp. compensation. |
| 5. | Accuracy | : | +/- 1% |
| 6. | Response time | : | < 1 minute. |
| 7. | Power Supply | : | 240 V AC, +/- 10%, 50 Hz. From UPS |

3.03.36**PULL CORD SWITCH**

- | | | |
|-----------------------|---|---|
| Type | : | Addressable Type |
| Body | : | Cast Iron |
| Contact rating | : | Continuous 10 Amp, Breaking 2 Amp. (240 V AC) |
| No. of contact | : | 2 NO + 2 NC |
| Reset facility | : | Manual Reset |
| Type of enclosure | : | Die Cast Aluminum |
| Degree of protection | : | Flame proof/Explosion proof for NEC class 1, Division 1 area |
| Local trip indication | : | Required |
| Accessories | : | <ol style="list-style-type: none"> 1. Canopy over lever of pull Cord switch. 2. Linking of switches through a single cable for each section. 3. Each pull cord switch shall be provided with red LED indication lamp for prominent visible indication of tripping. 4. "One number indicator panel which shall display the exact number of safety switches (pull cord and belt sway switches) operated in a loop of conveyor. It shall also monitor the condition of field cable connecting the switches in series & generate signal if field cable is found broken or short. The indicator panel shall display the operated switch number. The same indication shall also be available in CHP PLC operator station. |

3.03.37**BELT SWAY SWITCH**

- Failure Diagnostics
- Long Term Stability
- Fast Response
- IP 66 / NEMA4X Protection
- Supplied with Calibration Certificate Traceable to National & International Humidity Standards
- Sensor protection with sintered filter
- Local LCD Display for Dew Point

3.03.42

Junction Boxes

v.	Type	:	Flame proof/weather proof
vi.	Enclosure	:	IP-65/Explosion/Flame Proof as per area classification.
vii.	Material	:	FRP with protective Coating
viii.	Cable entry	:	Bottom or Side
ix.	Cable glands	:	Double compression type – Nickel plated brass with PVC hoods.
x.	Mounting	:	Indoor/Outdoor
xi.	No. of terminals	:	As required with standardization with 20% spare of each size & type.
xii.	Terminals	:	Phoenix/Wago (screw less cage clamp type spring loaded)
xiii.	Grounding	:	Two terminals for body and shield ground
xiv.	Door	:	Hinged, lockable type.
xi.	Suitable mounting clamps and other accessories shall be in scope of bidder.		
xii	The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of brass, included in bidder scope of supply. High voltage & insulation resistance test shall also be conducted.		
Xiii	M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.)		
xiv	Gasket (Normal)- Neoprene thickness 6.0 mm		

3.03.43

Interposing Relays (IPR)

Electro magnetic type IPRs with modular design, plug-in type connections, suitable for channel/DIN rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated change over contacts rated for 0.5A 220 V DC/8 A 240 V AC. Free wheeling diode across relay copper coil and self reset type status LED indicator flag (electronic) shall be provided. Manual forcing/override facility is required. The test voltage for relay shall not be less than 4 KV with operating temperature from –20 deg. C to 60 deg. C. The relay shall have the necessary approvals like V0 inflammability class in accordance with UL94”, IEC60664/IEC60664A/DIN VDE 0110. Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing relay shall be of same make only.

~~3.03.44~~~~**RECORDERS (CHARTLESS)**~~

Type	:	Micro-processor based, Digital TFT display type
- No. of Channels	:	Forty Eight (48) point).



Input	:	110 V PT Volts
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.57 TRANSDUCERS FOR POWER FACTOR

Input	:	PT (110V)
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.58 TRANSDUCERS FOR MVAR

Input	:	CT & PT (110V/1A)
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.59 DIFFERENTIAL FREQUENCY TRANSDUCERS (FOR SYNCHRONIZATION)

Input	:	110 V PT
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.60 DIFFERENTIAL VOLT TRANSDUCERS (FOR SYNCHRONIZATION)

Input	:	System voltage
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.61 PUSH BUTTONS (PB)/ ILPBs FOR ON/OFF, OPEN/CLOSE, START/STOP

Type	:	Momentary/Miniaturised Suitable for mosaic grid 24x48 Mm with 2 PB and 3 coloured LED.
------	---	--

Contact Configuration	:	2 NO + 2 NC
Contact Material	:	Hard Silver Alloy
Contact Rating	:	500V / 10 A
Insulation Voltage	:	2 KV for 1 minute between

terminals and earth

Lamp Rating :-

a) Voltage	:	240 V AC
b) Watt	:	2 Watt (approx.)

Colour



- Red – ON/Start/Open ILPB
- Green – OFF/Stop/Close ILPB
- Red - energized, running, Start, valve open LED/Lamp
- Green - de-energized, stopped, valve closed LED/Lamp
- Light yellow - abnormal, discrepancy LED/Lamp
- Red – OFF/Stop/Close PB
- Green – ON/Start/Open PB
- Red** - Emergency trip push buttons with red flap / hinged Transperent arylc cover.

- 3.03.62 PUSH BUTTON FOR Control DESK:** **Momentary mosaic grid mounted**
24x48 mm size, single PB 18x40 mm
Colours for DESK RELEASE - Yellow,
Desk Lamp test - Blue, Desk Ack - Green
- 3.03.63 PUSH BUTTON FOR SEQUENCE START/RELEASE :** Momentary (Miniaturised) suitable
for mosaic grid 24x48 mm
3 PB + 5 LED
- 3.03.64 PUSH BUTTON FOR ANNUNCIATION**
- Contacts
- Number & Type : As per requirement
 - Breaking capacity : 1 Amp, 220V DC
10 Amp, 600V AC
- Different colours for Accept/Ack - Green, reset Grey, Lamp test – Blue, System Test – Yellow & Audio Ack - Black.

3.03.65	<u>BELT WEIGHING SYSTEM</u>
3.03.65.1	General
	The mechanical design and constructional features for belt weigher has been described under mechanical section, hence not repeated here, Similarly motor specifications for the same has been covered under electrical specification, hence not repeated here.
	The belt weighing system shall have its own local control panel to be located in electrical equipment room. The local panel shall include: (a) Local flow rate indication (b) Integrated flow rate indications (c) System alarm annunciation (d) Local Calibration facility (e) Power on/off All these above display shall be backlit LCD type with 12mm character height. NI Cd Battery back up (60 minutes backup) shall be provided for the measurement system. (a)Application : Bulk material, Powder material (b)Drive Protection : Reverse Polarity, Communication failure



5.11.00 Technical Specifications of Conductivity Analyser

- | | | |
|----|---------------------|---|
| a) | Applicable standard | ASME PTC 19.11-1970 except as modified in this specification. |
| b) | Type: | |
| | i) Cell | Flow through type/ removable type (withdraw able with sealing valve) |
| | ii) Monitors | Electronic (Microprocessor based) indicating type with multi range facility |
| c) | Material : | |
| | i) Cell | Epoxy resin/SS316 |
| | ii) Electrode | Platinised/SS316 |
| | iii) Monitors body | Carbon steel/Aluminum/Polycarbonate |
| d) | Monitor output | |
| | i) | 4-20 mA D.C. with HART protocol spare out put |
| | ii) | 4-20mA DC with HART protocol for DDCMIS
Output load : 500Ω |
| e) | Power supply | 240V, AC, 50 Hz from UPS |
| f) | Accuracy | ± 1% of full scale span |
| g) | Stability | ± 1% of full scale per month
non-cumulative |
| h) | Repeatability | ± 0.3% of span |



- i) Annunciation contacts from monitors
- i) Number 2SPDT
- ii) Type Snap action micro switch
- iii) Rating 5 amp, 240 V, 0.2 Amp, 220V DC
- j) Connection:
- i) Cell On line/pipe mounted
(ON LINE in sample table)
1/4 (Quarter) inch NPT (F) SCRD for on-line type and Three quarter (3/4) inch NPT (M) SCRD for pipe mounted.
flush panel mounting
- ii) Monitors
- k) Electrical Half (1/2) inch NPT (F) SCRD
- l) Accessories
- i) Automatic temperature compensation in the range 0-100°C
- ii) Ammonia (NH₃) removal equipment.
- iii) Sample coolers
- iv) Flow and pressure regulators
- v) SS316 impulse tubing and fittings
- vi) Isolation & drain valves as required
- vii) Other accessories as required
- viii) Adequate length of cables for connecting coils to monitors
- ix) Sample rate set valves
- x) Alarm settings and Alarm indications on monitor.
- m) Other particulars Cell shall be suitable for maximum pressure of 7 kg/cm² and maximum temp. of 100°C
- n) Response time ≤ 3 seconds



5.12.00 Technical Specification of pH Cell and Transmitters

- | | | |
|----|--------------------------------------|--|
| a) | Applicable Standard | pH electrodes shall conform to IS: 6804-1972 except as modified in this specification |
| b) | Type: | |
| | i) Cell | Measuring and Reference Electrode Combination with Flow through type (SS316/Polypropylene flow chambers) for power plant's steam & water application. Sensor shall not be affected by flow variation. Sensor shall be designed for power plant applications. |
| | ii) Monitors | Electronic (microprocessor based) indicating type with adjustable range facility. |
| c) | Material: | |
| | i) Measuring & reference | Toughened sensitive |
| | ii) Electrode | pH glass |
| | iii) Monitor body | Carbon steel/Aluminum/Polycarbonate |
| d) | Monitor output | |
| | i) | 4-20 mAmp D.C. with HART protocol spare out put |
| | ii) | 4-20mA DC with HART protocol for DDCMIS
Output load : 500Ω |
| e) | Power supply | 240V AC, 50 Hz from UPS |
| f) | Accuracy/repeatability | + 0.03 pH/+0.02PH |
| g) | Resolution | + 0.01 pH or 1 mV. 1C |
| h) | Stability | 0.02 pH per week |
| i) | Annunciation contacts from monitors: | |



- | | | | |
|----|-------------|---|--|
| | i) | Number | 2 SPDT 'Hi' and 'Lo' |
| | ii) | Type | Snap action micro switch |
| | iii) | Rating | 5 amp, 240V AC, 0.2 Amp, 220V DC |
| j) | Connection: | | |
| | i) | Process | One-quarter (1/4)inch NPT(F) SCRD
ON-LINE |
| | ii) | Electrical | Half (1/2) inch NPT(F) SCRD |
| k) | Mounting: | | |
| | i) | Cell | Pipe Mounted |
| | ii) | Monitors | Flush panel mounting |
| l) | Accessories | | |
| | i) | Automatic temperature compensation with fast response integral temperature sensors in the range 0-100°C | |
| | ii) | Co-axial cable as required | |
| | iii) | Sample coolers | |
| | iv) | low and pressure regulators | |
| | v) | Standard pH solutions | |
| | vi) | SS316 impulse tubing and fittings | |
| | vii) | Isolation & drain valves as required | |
| | viii) | Electrode holders | |
| | ix) | Other accessories as required | |
| | x) | Sample rate set valves | |
| | xi) | Alarm settings and indications on monitor. | |
| | xii) | RFI/EMI shielded, weather and corrosion proof casing | |



5.14.00 Technical Specification of Silica Analyzer (SI OX)

- | | | |
|----|---------------------|---|
| a) | Applicable standard | ASME PTC 19.11-197 except as modified in this specification |
| b) | Type | Multi Channel (max of each Three channel)
Colorimetric Analyzer (with auto reagent shut off feature in case of sample loss or power loss) built in phosphate inhibition feature. Micro processor based. |
| c) | Material: | |
| | i) Case | Die cast aluminum |
| d) | Cycle/Response Time | Twelve (12) minutes Maximum |
| e) | Analysers output | i) 4 to 20 m Amp DC for spare output
ii) 4 to 20 m Amp DC Isolated output for DCS/PLC |
| f) | Power supply | 240V AC, 50 Hz from UPS |
| g) | Accuracy | $\pm 1\%$ of span |
| h) | Repeatability | $\pm 2\%$ of full scale |
| i) | Sensitivity | 0.2 micrograms/liter |
| j) | Connection: | |
| | i) Process | Quarter (1/4) inch NPT(F) SCRD |
| | ii) Electrical | Half (1/2) inch NPT (F) SCRD |
| k) | Ranges | As per sample stream detail table |



- | | | |
|----|------------------------|--|
| l) | Mounting | Flush |
| m) | Annunciation contacts: | |
| | i) Number | 2 SPDT |
| | ii) Type | Snap action micro switch |
| | iii) Rating | 5 amp 240V AC 0.2 Amp 220V DC |
| n) | Accessories | |
| | i) | Automatic temperature compensation between 5 to 50 deg C |
| | ii) | Automatic zeroing provision |
| | iii) | SS316 tubing & vessels |
| | iv) | All chemical reagents for 12 months operation of the analyzer |
| | v) | Sample rate set values |
| | vi) | Comprehensive diagnostic and alarm features. |
| | vii) | Auto sampling facility with necessary valves & solenoids in the sample lines shall be provided. |

5.16.00 Technical Specification of Sodium Ion Analyzer

- | | | |
|----|------|---|
| i) | Type | Microprocessor based Continuous flow through sample type with sodium responsive |
|----|------|---|



		electrode and reference electrode having pH adjustment facility (Max 3 streams)
ii)	Case material	Die-cast aluminum/SS/Polycarbonate
iii)	Analyzer power supply	240V AC, 50 Hz from UPS
iv)	Analyzer output	i) 4-20 mA DC for spare output ii) 4-20 mA DC isolated output for DDCMIS
v)	Accuracy	Better than $\pm 5\%$ of full scale
vi)	Response Time	6 minutes. max
vii)	Sensitivity	0.1 ppb
viii)	Annunciation contacts:	
	- Number	2 SPDT
	- Type	Snap action microswitch
	- Rating	5A 240V AC, 0.2A, 220V DC
	- Mounting	Flush
ix)	Terminal points	All components piped & wired to terminal points
x)	Accessories	i) Flow regulator ii) Flow gauges iii) Sample rate set valves iv) Other accessories as required to make the system complete v) Chemical reagents as applicable for 12 months consumption

5.18.00 Technical Specification of Chloride Analyzer

- | | | |
|-------|------------------------|--|
| i) | Type | Microprocessor based Continuous flow through sample type. |
| ii) | Analyzer power supply | 240V AC, 50 Hz, Single Phase from UPS |
| iii) | Analyzer output | i) 4-20 mA, DC spare output
ii) 4-20 mA, DC isolated output for DDCMIS |
| iv) | Accuracy | Better than ± 10 % of full scale |
| v) | Sensitivity | Better than 1 ppm |
| vi) | Range | As per Requirements. |
| vii) | Annunciation contacts: | |
| | - Number | As per schedule, 2 SPDT |
| | - Type | Snap action micro switch |
| | - Rating | 5A, 240V AC, 0.2A, 220V DC |
| | - Mounting | Flush |
| viii) | Terminal points | All components piped & wired to terminal points |
| ix) | Accessories | i) Flow regulator
ii) Flow gauges
iii) Sample rate set valves
iv) Other accessories as required to make the system complete |

5.19.00 Technical Specification of Chlorine Analyzer

- | | | |
|------|------------------------|---|
| i) | Type | Microprocessor based Continuous flow through sample type with automatic temperature compensation. |
| ii) | Analyzer power supply | 240V AC, 50 Hz, Single Phase from UPS |
| iii) | Analyzer output | i) 4-20 mA, DC spare output
ii) 4-20 mA, DC isolated output for DDCMIS |
| iv) | Accuracy | 0.005 mg/ltr. or 1% of range. |
| v) | Sensitivity | 0.001 mg/ltr. (1 ppb) |
| vi) | Range | As per schedule. |
| vii) | Annunciation contacts: | |
| | - Number | As per schedule, 2 SPDT |



	-	Type	Snap action micro switch
	-	Rating	5A, 240V AC, 0.2A, 220V DC
	-	Mounting	Flush
viii)		Terminal points	All components piped & wired to terminal points
ix)		Accessories	i) Flow regulator ii) Flow gauges iii) Sample rate set valves iv) Other accessories as required to make the system complete

5.20.00 Technical Specification of Residual Chlorine Analyser

SENSOR

Method	:	Amperometric
Electrodes	:	Gold Cathode/Silver Anode
Cell Material	:	PVC
Electrolyte	:	Potassium Bromide

TRANSMITTER

Type	:	Microprocessor Based with self diagnostic features
Transmitter Output	:	4 – 20 mA
Enclosure Protection	:	IP65
Enclosure Material	:	Polyester coated Al.
Electrical Connection	:	½" NPT (F)
Mounting	:	FIELD
Display Type	:	LCD
Display Details	:	4 digit backlit LCD matrix
Diagnostics	:	Required
Meter Range	:	0-1 mg/l
Resolution	:	0.01 ppm
Area Classification	:	SAFE
Electromagnetic Compatibility	:	BUILT – IN
Temp. Compensator	:	AUTO – BUILT – IN
Temp. Compensating element	:	PT100



CHAPTER-12**FLOW ELEMENTS**

12.00.00 This specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR'S/SUB-VENDOR'S WORKS and delivery to site of Flow Elements.

The equipment furnished to this specification shall conform exactly to the requirements herein, unless modified by the respective Data Sheet of the equipment.

12.01.00 The design, material, construction features, manufacture, inspection and testing of flow elements shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

12.02.00 Technical Requirement

316SS long radius, weld in flow nozzles with D and D/2 pressure tapings; 316SS flow orifice plate assembly with flange tap connections; β ratio of 0.4 to 0.7. Element material of SS 316. The material of Flow nozzle shall be A182F91, where pipe material is A335P91. The material of all type of accessories will be SS316. End connections for flow elements will be butt welded except orifice plate on condensate return line to CST, which will be flanged. The accuracy of the flow element shall be $\pm 0.5\%$ or better.

Standards

The flow elements (Orifice plates) shall be designed in accordance with ASME PTC – 19.5 (Pt – II), ISA RP3.2, 1960 or BS 1042/ISO 5167.

The flow elements (Flow Nozzles) shall be designed in accordance with ASME PTC – 19.5 (Pt – II), or BS 1042/ISO 5167.

Construction and installation of flow nozzles and orifices shall conform to the requirements of ASME Performance Test Code PTC-19.5 as mentioned above and discharge coefficients shall be predicted in accordance with data published in ASME Research Report on Fluid Meters.

Flow nozzles shall be provided for critical measurements where weld-in construction is required. Flow nozzles shall be made with quater, triple or dual sets of pressure taps installed in the pipe wall where required considering spare one set of pressure tap. Installation of flow nozzles and pressure taps shall be made in the pipe fabricator's shop.

Anubars shall be used where pressure loss is critical and/or conditions permit their reliable installation.

Concentric orifice plates shall only be provided for other flow measurements where flanged construction and higher pressure losses are acceptable. Orifice plates shall be



made of stainless steel. Orifice flanges shall be of the raised face weld neck type with dual sets of taps. Thickness of Orifice plate shall be 3 mm for pipe diameter up to 300 mm and 6 mm for pipe diameter above 300 mm.

Coriolis principle based mass flow meters shall be used for flow (mass & volume) measurement of liquid fuel.

Aerofoil/ Venturi tubes shall be provided for Air flow measurement.

Flow element shall be accompanied by IBR certification. Hydraulic test pressure shall be considered 1.5 times of design pressure at normal temperature.

SS nameplate to flow elements shall include Tag no/ KKS No./SI. No./ Body Material/Beta ratio/line size & thickness/ direction of flow.

BIDDER to ensure that maximum pressure drop/loss shall be limited to 30% of Differential Pressure for flow Nozzle & 60% of DP for Orifice plate.



12.05.00 PERFORMANCE

The Bidder shall submit type test certificate from a recognized test house certifying evaluation of construction standard, accuracy of calibration.

12.06.00 TESTS AND INSPECTION

All equipment components shall be individually tested to ensure correct functioning. Following tests shall also be conducted:

- a) Calibration test
- b) Dimensional check
- c) Material test

Wet calibration shall be carried out as on each size and design of flow element as per ASME PTC or BS 1042/ISO 5167. The other tests shall conform to ASME-PTC 19.5. The Bidder shall submit the reports for all the tests carried out for Owner's review and records. The functional test shall also be witnessed by owner as per approved QAP.



CHAPTER-11**CONTROL VALVES WITH ACTUATORS****11.00.00 CONTROL VALVES, ACTUATORS AND ACCESSORIES****11.01.00 GENERAL REQUIREMENTS**

11.01.01 This section covers the design and construction requirements of Control Valves, their Actuators and Accessories. Except as otherwise specified herein, the Control Valves and accessory equipment furnished under this specification shall be designed, constructed and tested in accordance with the latest applicable requirements of code for Pressure Piping ANSI B31.1, the ASME Boiler and pressure vessel code, Indian Boiler Regulation (IBR) and other standards referenced herein as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA", or acceptable equal standards.

11.01.02 The design of Control Valves shall comply with relevant codes and standards, account for relevant design criteria viz. environmental conditions, power and air supply, established reliability (reliability target and life expectancy), design of enclosures as specified in Sections earlier.

11.01.03 All Control Valves and accessories furnished under the Section shall be of Owner approved make, fully meeting the qualifying requirements.

11.01.04 Each control valve station shall be provided with pneumatic bypass control valve or Inching type motorised bypass valve as per process requirement and subject to owner approval. In addition each control valve shall also have upstream motorised valve. Downstream motorised valve shall also be provided as per process requirement and as finalized during detailed engineering.

11.02.00 CONTROL VALVE CONSTRUCTION AND SIZING**11.02.01 General**

1. Valve Construction shall be in accordance with the requirements specified herein. (Bidder to also refer NIT drawing # 114-18-0100).
2. The design of all valve bodies shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.
3. The valve sizing shall be suitable for obtaining maximum operating conditions with valve opening at approximately 80% of total travel. Valves shall be open not less than 15 % of full opening for minimum flow condition and shall be capable of handling at least 120% of the required maximum flow at full open condition. Actual pressure drop is indicated in the specification sheets. Permissible pressure drop shall be calculated and



used by the Bidder for sizing calculations. Valve sizing shall be in compliance with the latest edition of ISA Handbook on control valves, ISA standards "ANSI/ISA-75.01.01, Flow Equations for Sizing of Control Valves" with due consideration for the measures to avoid choked flow. Bidder shall ensure that the valve outlet velocity does not exceed 8 meters/second for liquid services, 150 m/second for steam services and 50% of sonic velocity for flashing services by selecting proper body size for the required Cv.

4. a. The Bidder shall provide valves designed to prevent cavitations, wire drawing, flashing on the downstream side of valve and in downstream piping, when operating through full range under the specified conditions.

For cavitating services, valves with anti cavitation trims shall be offered. This shall ensure cavitation prevention by multiple stages of pressure drops. Detailed calculations shall be furnished by bidder to establish cavitations occurrence or otherwise for various process conditions each service wise.

For flashing services such as heater drains, control valve design shall be specially effected to ensure suitability for the adverse high pressure drops and minimise its detrimental effects on control valve parts.

Bidder shall furnish detailed catalogue, calculations, write ups to establish compliance to these stipulations with the selection of each valve. No price implications during engineering stage would be admissible to comply with these stipulations and intents of specification.

- b. The Liquid pressure recovery factor (FL) shall be 0.995 or better for severe flashing/cavitation services.
 - c. The Liquid pressure recovery factor (FL) shall be 0.985 or better for low flashing/cavitation services.
5. Each valve shall be designed for tight shut-off against pressure, the valves shall have maximum permissible leakage rate as per ISA RP 39.6 Leakage Class IV (0.01% of rated valve capacity) or specified other wise.

~~Control Valves for Application such as HP/LP heaters emergency level control, SH spray & RH Spray control, Emergency makeup to Hotwell, Deaerator drain to condenser hotwell & heavy oil heating, HFO & LDO and Pressurizing control system, condenser normal make up control valve shall have permissible leakage rate as per leakage class V (ANSI/FCI).~~

All SH/RH block valves, shut off valve of LDO & HFO and BEP recirculation valve shall have leakage class MSS-SP-61.



6. The valve design shall take into account noise abatement considerations. The design objective will be to limit the generation of valve induced noise to 85 dBA at 1 Meter from the valve surface under actual operating conditions. The noise abatement shall be obtained by valve body and trim design and piping arrangement and not by the use of silencers.
7. The Bidder shall be responsible for proper sizing of the valve and selection of appropriate model and materials of constructions for meeting the operating requirements specified herein and details subsequently furnished during the detailed engineering stage.
8. The valve travel time shall be less than 10 second for non critical services valves.
9. Rangeability should be 50 to 1 (min.) for non critical services valves.
10. Control Valve's Linearity, Hysteresis, Accuracy shall be $\leq \pm 1\%$ and Sensitivity shall be $\leq \pm 0.5\%$.

Bidder shall furnish the Control Valve data sheets and sizing calculations with the proposal which will be subjected to owner approval during detailed engineering. The bidder shall furnish all valves as per Owner approved data sheets and drawings.

11.02.02 **Valve Construction**

1. All valves shall be of globe body design and straightway pattern. Straightway pattern valves shall be either single or double ported as specified. Double ported and single ported valves shall have high lift cage guided plugs, unless otherwise specified.
2. Where specified, valves with cage guided plugs and quick change trim shall be supplied. The quick change trim shall consist of a cage and seat ring clamped in the valve body by the valve bonnet and sealed with a spiral wound stainless steel asbestos gasket. The trim shall be removable through the top after bonnet removal without any cutting or welding of the valve. Where applicable, plugs shall be designed to include pressure balancing for cage guided valves.
3. Direct acting and self-contained pilot type valves may have low lift plugs.
4. Cast iron valves are not acceptable.
5. Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Owner. Bonnet joints shall be designed for easy disassembly and for assurance of correct valve stem alignment. Bonnet joints of the internal threaded or union type will not be acceptable.
6. Plugs shall be of one-piece construction either cast, forged, or machined from solid bar stock. Plugs shall be screwed and pinned to valve stems or shall be integral with the valve stems.



7. When Teflon packing is used, the lower valve stem which passes through the stuffing box shall be polished to at least 2×10^{-4} millimeters r.m.s.
8. Valves gland packing shall normally be Teflon on liquid and gas services up to 100 kg/cm^2 and 230 Deg.C Teflon impregnated asbestos shall be used above 230 Deg.C and graphite impregnated asbestos with lubrication shall be used for steam services.
9. All valves shall be arranged so that the plugs may be removed from the valve bodies from the bonnet side.
10. Each valve shall have an arrow permanently fixed on the valve body to indicate the correct direction of flow.
11. Each valve shall have a stainless steel name plate permanently fastened to the yoke which shall be visible when the valve is in service. The name plate shall include
 - a. Tag No. and Valve Serial No.
 - b. Body material, size and pressure rating
 - c. Trim material, size characteristics
 - d. Action on air failure
 - e. Spring range
 - f. Stem travel
 - g. Valve action, etc.

11.02.03

Valve Materials

1. Valve material shall be as specified in Supplier's approved Control Valve Specification sheets. The following table defines abbreviations used for valve materials:

S.No.	Abbreviations	Description
a	BR	Bronze ASTM B 61
b	CS	Carbon Steel Forged - ASTM A 105 Cast - ASTM A 216 Grade WCC
c	1- ¼ CR	1-1/4 % Chromium Alloy Steel Forged – ASTM A 182 Grade F11 Cast – ASTM A 217 Grade WC6
d	2- ¼ CR	2-1/4 % Chromium Alloy Steel Forged – ASTM A 182 Grade F22 Cast – ASTM A 217 Grade WC9
e	5 CR	5% Chromium Alloy Steel Forged – ASTM A 182 Grade



		F5 Cast – ASTM A 217 Grade C5
f.	SS	Stainless Steel AISI Type 316 ASTMA 351 Grade CF8M

2. Body material shall be selected by the Bidder to be compatible with the nature of the fluid, service conditions, and piping material to which it is welded and shall be subjected to Owner approval. In general, cast or forged carbon steel bodies shall be provided for non-corrosive process applications up to 275 Deg.C. Alloy Steel castings shall be provided when the media is non-corrosive and the temperature exceeds 275 Deg.C and is within 550 Deg.C. Stainless Steel of suitable grade shall be provided when media is corrosive and the temperature is below 300 Deg.C.

Sr. No.	Service	Body Material
1.	Non Corrosive, Non Flashing, and non cavitations service for process temp. up to 275 deg. C like Aux. steam flow to Deaerator, Cond. Flow to deaerator, Fuel Oil, Atomising steam service etc.	Cast Carbon Steel ASTM A216 Gr. WCB/WCC
2.	Non Corrosive, Non Flashing, and non cavitations service for process temp. above 275 deg. C. and up to 550 deg. C. and for CRH flow to Deaerator.	Cast Alloy Steel ASTM A217 Gr. WC9
3.	Severe Flashing/ cavitations service like Feed Control Valve, Spray Control valves, LP/HP heater emergency level control valve, HP BP spray control valve, Deaerator Overflow control valve etc.	Cast Alloy Steel ASTM A217 Gr. WC9
4.	Low Flashing/ cavitations service like LP/HP heater normal level control & Condensate/feed water below 275 deg. C.	Cast Alloy Steel ASTM A217 Gr. WC6
5.	DM Water Application (Condenser Hotwell normal & Emergency make up etc.)	Cast type 316 Stainless Steel ASTM A351 Gr. CF8M

3. Unless otherwise specified, all control valves shall have stems, guide bushings, plugs, seat rings, stem lock pins, stuffing box parts, and other trim, all made of stainless steel. Valve guide posts and bushings shall be stellite faced for valves where specified. Stellite faced guide posts and bushings shall be differential hardened. For applications involving high pressure drop as also for flashing and cavitation services, trim material shall be properly chosen to ensure required degree of hard facing (such as 17-4 PH SS) so as to avoid erosion.

Sr. No.	Service	Trim Material
1.	Non Corrosive, Non Flashing, and non cavitations service for process temp. up to 275 deg. C. like Aux. steam flow to Deaerator, Cond. Flow to deaerator, Fuel Oil, Atomising steam service etc.	SS316 Stellited
2.	Non Corrosive, Non Flashing, and non cavitations service for process temp. above 275 deg. C. and up	SS316 Stellited



	to 550 deg. C. and for CRH flow to Deaerator.	
3.	Severe Flashing/ cavitations service like Feed Control Valve, Spray Control valves, LP/HP heater emergency level control valve, HP BP spray control valve, Deaerator Overflow control valve etc.	440 SS
4.	Low Flashing/ cavitations service like LP/HP heater normal level control & Condensate/feed water below 275 deg. C.	17-4 PH SS
5.	DM Water Application (Condenser Hotwell normal & Emergency make up etc.)	17-4 PH SS

4. Where stellite facing is not specified, hardened stainless steel shall be furnished for all surfaces subject to wear.
5. Manufacturer recommended materials for cage guided valves may be substituted for materials specified provided they satisfy the specified service conditions. Also where substitutions are made, the manufacturer shall guarantee performance of recommended materials to be equal to or better than the specified materials for conditions specified.

Bidder may offer valve with body and trim material better than the specified material and in such case, bidder shall furnish the comparisons of properties including cavitations resistance, corrosion resistance, temp. resistance, erosion resistance, hardness etc. of the offered material vis a vis specified material for owner approval.

11.02.04 **End Preparation**

1. Valve body ends shall be butt-welded type.
2. Flanged ends shall be of a pressure class equal or greater in pressure-temperature rating to the body design pressure and temperature indicated on the control valve. Unless otherwise specified, steel flanges shall be raised face type. Flanged ends for valves shall be in accordance with ANSI B 16.5.
3. Welded end for control valves where specified shall be socket-weld per ANSI B 16.11 for control valves of sizes 50 mm (2") and below and Butt welded connections per ANSI B16.25 for control valves 65 mm (2-1/2") and above. The end preparation for butt welded control valves shall be matched to the corresponding details for the piping on which the valve is installed.
4. All end preparations shall be as per Owners requirements indicated during Contract stage.

11.02.05 **Miscellaneous Parts**

1. Extension bonnets shall be used on all valves when the maximum temperature of the flowing fluid is greater than 275 deg. C or when specifically required in the control valve.
2. Stem travel indicators shall be provided on all valves.



11.03.00 VALVE OPERATIONS

- 11.03.01 All control valves shall be furnished with pneumatic spring opposed diaphragm, spring less diaphragm, or piston operators as specified herein.
- 11.03.02 The bidder shall be responsible for proper selection and sizing of valve operators in accordance with the pressure drop and maximum shut-off pressures.
- 11.03.03 Valve operators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance of stem force, at least 0.15 kg/sq. cm per linear millimeter of seating surface, shall be provided in the selection of the operator to assure tight seating unless otherwise specified. The operators shall be designed to produce the required stem force with supply air pressure of 3.5 kg/sq. cm maximum unless otherwise specified.
- 11.03.04 Diaphragms shall be moulded synthetic rubber and diaphragm housing shall be of pressed steel construction. Diaphragms shall not be fabricated of natural rubber.
- 11.03.05 Piston operators shall use cast pistons and cylinders with O-ring seals. Operators shall be supplied with name plates which indicate the diaphragm air pressure at full open and full closed positions. for single seated valves the pressures shall be listed for maximum differential and for zero differential across the valve.
- 11.03.06 Pistons and cylinders shall be cast aluminum. Piston rod and extension shall be chrome plated stainless steel. Cylinder seal bushings shall be brass and seal rings shall be nitrile. Yoke shall be cast iron.
- 11.03.07 Valve operators shall be capable of operating at 60 °C continuously.

11.04.00 CONTROL VALVE ACCESSORIES & DEVICES

The following accessory equipment shall be provided for control valves:

- 11.04.01 **Air Locks:** Air locks shall be designed to shut off the diaphragm loading air line if the supply air pressure to the associated pilot or Positioner fails. Air locks shall be of the automatic reset type and shall be furnished with alarms.
- 11.04.02 **Hand Wheels:** Hand Wheels shall be provided. Hand wheels shall be side mounted unless specified to be top mounted. However the mounting shall be as decided during engineering to offer maximum accessibility.
- 11.04.03 **Limit Switches:** Each control Valves shall be provided with limit switches for monitoring of end position in DDCMIS/DCS/PLC. Switches shall have not less than two normally open and two normally closed contacts in both open and close directions. Electrical rating of the limit switch contacts shall be 240V AC, 5 amp or 220V DC, 0.5 amp. Limit switches should be National Acme Co., or Honeywell micro switch type or Owner approved equal. The enclosures of the limit switches



shall be as per NEMA-4 Standard. Limit switches shall be constructed to withstand the temperatures encountered in the actual service. Explosion proof construction shall be furnished where required by applicable code or these specifications. Limit switches shall be factory mounted on the valves with provisions for adjusting the mounting. The Bidder shall stroke the valves to check limit switch operation prior to shipment.

Limit/micro switches can be offered as an integral part of Smart valve positioner.

- 11.04.04 **Smart Valve Positioner:** Control valve actuators for modulating and throttling services shall be provided with HART protocol based smart electro pneumatic valve Positioner to ensure accuracy & repeatability of response. The valve Positioner shall be designed suitable for vibration and service conditions of a steam electric power station.

The Positioner shall have the following features:

- a) Shall provide a pneumatic output signal of range 0.2 to 1.0 kg/cm² or as desired for the actuator.
- b) Shall have integral type position transmitter, input & output gauges, local keypad, display, 4-20 mA input and 4-20 mA output for position indication in DDCMIS/CCR/PLC.
- c) Shall be suitable for direct mounting on control valve assembly both for rotary & linear valves.
- d) Shall be capable of functioning under hot, humid & vibrating conditions.
- e) Shall have dust tight, corrosion resistant & weather proof IP 65 metal casing.
- f) Shall be operated at signal range of 4-20 mA for full travel of the valve. Split range operation in few case may be required. This facility shall also be available in positioner.
- g) Shall have in built mechanical position indicator.
- h) Shall have fail safe & fail freeze function as per loop process requirement.
- i) Shall have in built auto tune facility.

- 11.04.05 **Solenoid Valves:** Solenoid Valve will be provided for the following

- i. **ON / OFF Duty type Control Valve**
- ii. For over-riding the controller signal with Modulating type Control valves.
- iii. For control valve stay put position requirement on controller signal failure with Modulating type Control valves.
- iv. For construction and detailed specification of Solenoid valve, Chapter 3, Vol. V shall be referred by bidder.

- 11.04.06 **Diffusers :** Diffusers shall be provided as per service application requirements. The diffuser shall be designed to reduce the pressure drop across the control valve below the critical value and reduce the sound pressure level. Details of the diffusers shall be submitted.



11.04.07 **External Volume Chambers:** External volume chambers with adjustable bleed valves shall be provided for Control Valve. Volume chambers shall be furnished, mounted on the control valve yoke assembly.

11.04.08 **Position Transmitters:** Position transmitters shall be provided for control valves as a part of smart positioner. The signal shall be 4-20 mA DC range, 24 V DC. For non smart positioners applications and power cylinders, contact less position transmitter shall be provided by bidder.

11.04.09 **Tubing and Air Sets:** All pneumatic tubing required to interconnect devices assembled together shall be furnished complete with each control valve. The tubing shall be fully annealed soft temper copper tubing conforming to ASTM B68 to B75 (USA). Swage lock flare less tubing fittings shall be used for tubing connections (Swage lock or approved equal).

Each device requiring an air supply shall be equipped with a combination filter-regulator. Devices mounted together on a valve yoke may be served by a single regulator, provided the supply pressure is satisfactory and the regulator capacity is not exceeded. Filter-regulators shall be mounted on the device served.

Filter- regulators shall be suitable for a 10 kg/sq. cm maximum inlet pressure. Filter-regulators shall have built-in housing blow down valves and a 2 inch pressure gauge. The filter shall be of size not more than 5 microns and shall be made of sintered bronze.

11.04.10 **Pressure Switch**

Pressure switch suitable for the above the pneumatic system shall be provided. The contact rating shall be 2 A for 240 AC, .2 A, 220 VDC 2 SPDT Contact. Enclosure IP 65.

11.04.11 **I/P Converter**

For non smart positioners applications and power cylinders i/p converters shall be required and owner approval shall be obtained for the use of i/p converter for such applications.

Electro-pneumatic, outdoor type, field mounted Linear. 4-20 MA DC input and 0.2 – 1.0 kg/Cm² output. Die cast aluminum casing with IP65 or equivalent enclosure class. Accuracy of $\pm 0.5\%$ of span or better and repeatability of $\pm 0.5\%$ of span or better will be provided. Easily accessible span and zero adjustment will be provided I/P converter shall be provided with all accessories and erection hardware. The I to P converters shall retain the pneumatic signal (last value) even in failure of control signal and shall have self volume boosters.

11.04.12 **Separate moisture separator unit** for ensuring dryness of air entering I/P as well as the power cylinder is to be supplied **with each control valve and control damper.**

11.05.00 **FOR FOLLOWING CRITICAL APPLICATION SPECIAL CONTROL VALVES ARE REQUIRED.:**



- iv. **Back up panel system** shall be designed for handling ~~the situation in clause 2.12.00 for failure of HMI.~~
- v. **For electrical layout, complete backup panel with mosaic** shall have to be provided for complete on/off operations with necessary meters, DDU's, synchroscope etc. as specified elsewhere in specification.
- iv. Control panel cum desk with HW annunciation windows, ILPBs, Ammeters, PBs, voltmeters, indicators, mimic, recorders etc. shall be provided as per Annexure A – Control System Philosophy for BOP packages. Profile/Overall GA of backup control panel cum desk for BOP packages shall be same as indicated in drawing no. 114-05-0105 attached with NIT.

2.06.00**PROTECTION, CLASS OF CABINETS / PANELS, ENCLOSURES ETC.**

- a) All panels, desks cabinets, consoles & enclosures furnished at least comply with the requirements of protection classes as indicated below.
 - 1. In-door Air-conditioned (A.C.) areas - IP32/42 (min.)
 - 2. In-door Non A.C. areas:
 - (a) Ventilated enclosures - IP42
 - (b) Non Ventilated. IP 54
 - 3. Out-door IP55 / IP65
(As per the requirement)
- b) Distribution boxes, junction boxes, cold junction compensation boxes, terminal boxes and all other field mounted equipment to be furnished as per this specification shall have weather protection conforming to IP 65.
- c) The design of panels, cabinets, enclosures and packaging density of components mounted therein shall be such that the temperature rise does not exceed 10 deg. C above the ambient under the worst conditions.
- d) The panels housing electronic hardware shall be provided with flame and smoke detectors by bidder.
- e) Enclosures for peripheral equipments like printers, etc. shall take care of noise and shall ensure minimum possible noise disturb to the working personnel.

2.06.01

Guards, barriers and access doors, covers of plates shall be marked to indicate the hazard, which may occur upon removal of such devices. Danger or caution signs shall be used to warn of specific hazards such as voltage or current. The marking shall be permanently affixed to the equipment.

2.07.00**~~System Documentation~~**

6.15.00 Local Instrument Racks & Enclosure

Transmitters and switches located in the field shall be grouped together and shall be installed in the enclosure (closed transmitter racks) in case of outdoor area such as Boiler area etc. And in open type Rack in case of covered area. Racks shall be factory prefabricated & painted and complete with internal tubing, manifold valve, isolation valves, integral junction boxes with outside access door, illumination etc. Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging.

6.15.01 Closed Type Instruments/Transmitter Racks

- (a) Required number of Instruments/transmitter racks shall be furnished to house transmitters, switches and converters by grouping them suitably, area- wise / function-wise.
- (b) The Transmitter enclosure shall be constructed of 3 mm thick steel plate. The enclosures shall preferably be of modular construction and with two end plate assembly bolted to the frame.
- (c) The enclosure shall approximately be 1200 millimeters wide, 1000 millimeters deep and 2200 millimeters high to allow easy access to the internals. Racks shall be reinforced as required to ensure true surfaces and to provide adequate support for instruments and equipment mounted therein. Double interlocking doors with three point locking arrangement shall be provided and shall be arranged for maximum possible access to the interior. Center posts or any member which would reduce access shall not be provided.
- (d) Doors shall have concealed quick removal type pinned hinges and locking handles. Doors locks shall accept the same key all over the plant. Neoprene material Gaskets shall be used between all mating sections to achieve dust proof enclosure rating for the modules and a IP-65 waterproof and dust tight rating on the terminal boxes. All Enclosures shall have access doors on front side.
- (e) Bulkheads, especially designed to provide isolation from process line vibration shall be installed on modular bulk head plates of the transmitter enclosures to meet the process sensing line connection requirements. Removable top and bottom plates shall be furnished.
- (f) All internal wirings and/or data bus connections, if any, between the transmitters and terminal junction box shall run through flexible dust tight conduits connected to the terminal box hub. No exposed wirings within transmitter racks, both open and closed type, is admissible.
- (g) All racks shall have a common closed drain trough to connect transmitter drain points to a common header after suitable pressure breaking. Covered funnels shall be used for saturated liquid and steam service, where as, open funnels may be used for cold liquid services. The trough shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header.
- (h) Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with owner's recommendations.
- (i) **Service Power and Lighting**



- (i) Each enclosure shall be provided with universal type power receptacle, light fixture & LED lamps with wire guard and lighting switch etc. Lighting switches shall be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and power receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.
 - (ii) Power Supplies for miscellaneous devices shall be provided with 2P MCB located within the enclosures. MCB shall be mounted in Fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- (j) Control Air
- (i) A control air supply header shall be furnished in each enclosure having pneumatic devices. The header shall be 25 MM NB brass header stock drilled and tapped for 8 millimeter valves.
 - (ii) A valve with double compression end fittings shall be installed in each tap. Not less than three spare connections shall be furnished in each enclosure. The air header shall originate at a bulkhead penetration or fitting located in one of the bulkhead plates. Each pneumatic instrument shall have individual air shut-off valve.
 - (iii) Pressure reduction shall be achieved by air filter regulator sets. One filter regulator shall be furnished for each group of components making a system.
- (k) Service Air
- A 15 mm NB service air header shall be furnished in each enclosure housing draft and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge and valve quick disconnect connections. A hose for connecting each header to the draft instrument line four way valve shall be furnished. The hose shall be self-storing nylon tubing having a burst pressure 15 Kg/Sq. cm. The service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates.
- (l) Power supplies
- Bidder shall supply all required transformers, regulators and other power supply equipment to adapt sources of power to the requirements of the enclosure mounted equipment. This shall include but not be limited to internal instrument illumination transformers. The circuits shall be separately isolated with MCBs.
- (m) Equipment Installation
- Special attention shall be given in the piping layout to avoid air traps in liquid filled piping, or water pockets in piping.
- (n) Impulse piping/tubing



- (i) Transmitter enclosures shall be complete with impulse piping & tubing, valves from enclosure bulkhead connection to all instruments and necessary drain / blow down connections. The type ,size, material and pressure class of pipes/ tubes, fittings, valves etc. Shall be suitable for the intended applications.
 - (ii) Blow down piping / tubing may be shared, but individual instrument piping/ tubing and valves shall be furnished. Piping/ Tubing material within enclosures shall conform to the application requirements. The final flexible connection to each instrument shall be fabricated with a double offset so that it may readily be disconnected to permit "in situ" calibration of the instrument.
 - (iii) Bulkhead connection shall be used when instrument piping/tubing enters the enclosure. For instruments lines which enter through the bottom of the enclosure, the primary process line from the instrument valve shall be neatly installed, anchored and terminated at approximately 150 millimeters above the floor of the enclosure. The enclosure shall have a removable, gasketed floor plate to provide an effective seal around the incoming field primary process line. An angle shall be installed 600 millimeters above the floor, running the length of the enclosure for anchoring of incoming field process lines.
 - (iv) Pulsation dampeners shall be furnished wherever required.
 - (v) Drain pots shall be furnished for instruments measuring flue gas parameters and vacuum.
 - (vi) All liquid filled blow down lines, except those measuring vacuum shall be connected to a header extended through one end of the enclosure and turned downward for directing the blow down into drain. Gas filled lines and lines equipped with drain pots shall not be connected to the blowdown header. The connection between the blowdown valve and blow down header shall be constructed so that it can be removed to permit the connection of test instruments to the blow down valves.
 - (vii) The draft instrument line four-way valves shall be installed so that the quick disconnect fitting is readily accessible for connection with the service air hose.
 - (viii) Pipe and stainless steel tube welding shall comply with the provisions of the latest applicable ANSI code for Pressure piping.
 - (ix) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure for that instrument except for low pressure and vacuum measurement the test pressure will be as per piping standard.
- (o) Instrument tubing
- (i) Pneumatic tubing shall be installed in a neat workmanlike. It shall be supported frequently enough that it does not shake when subjected to vibration. All tubes which enter or leave the enclosure shall be terminated on bulkhead fittings in the bulkhead plate.
 - (ii) Pneumatic tubing material shall be 6mm OD brass/ 316 stainless steel tubing, unless otherwise specified. Flareless tubing fittings shall be used for tubing connections smaller than one inch. Tubing shall be stretched before installation to assure straightness. Special tools shall be used for all



bending and forming operations. Tubing shall be carefully handled to avoid flat spots, kinks, and short bends. All piping and tubing shall be air blown after erection and before attachment to equipment at either end.

6.15.02 Open Type Transmitter Racks

- (a) Open type transmitter racks may be provided for mounting Transmitters, switches, gauges, converters and other accessories in rooms, buildings and closed areas like the power house building.
- (b) The open type racks may be shop or site fabricated. Transmitters, switches, converters and transducers of enclosure class IP-65 or better can be directly mounted on open racks. However, enclosures not conforming to the above protection standard shall have to be housed in enclosures conforming to the above protection standard shall have to be housed in enclosures conforming to IP-65 class prior to mounting them on open structures.
- (c) Racks shall be constructed on structural members of adequate strength and rigidity to ensure proper support to the mounted instruments and equipment. Racks shall be of welded construction throughout. Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Each rack shall be provided with a canopy (sheet thickness of 3 mm) to protect the instrument from dripping water or falling objects.
- (d) For Operational convenience, the open type racks shall be used for mounting pressure and temperature gauges and switches and the local operating stations for electrical drives in the vicinity. Gauges mounted in racks shall be bottom connected and secured by double lock nuts. All gauges shall be located within 1500 mm from the floor for easy readability.
- (e) The structural design shall be such that no item shall interfere with maintenance and removal of instrument, equipment and their accessories.
- (f) Service Power and lighting
 - (i) Each rack shall be provided with Universal type power receptacle, LED lamp light fixture with wire guard and lighting switch etc. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack.
 - (ii) Power supply for respectacles and lighting shall be arranged. Power supplies for miscellaneous devices shall be provided with 2P MCB located within the rack JB. MCBs shall be mounted in blocks. MCB ratings will given on electrical schemetic diagrams. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- (g) Control Air
Same as for closed type transmitter rack. Refer 6.15.01 (j) above



- (h) Service Air
Same as for closed type transmitter rack. Refer 6.15.01 (k) above
- (i) Power Supplies
Same as for closed type transmitter rack. Refer 6.15.01 (l) above
- (j) Equipment installation

Contractor shall prepare rack fabrication and piping drawings indicating the layout of each instrument. The drawings shall clearly indicate contractor's piping arrangement for sharing of process connections between two or more instruments. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry.

- (k) Impulse Piping/Tubing
Same as for closed type transmitter rack. Refer 6.15.01 (n) above
- (l) Instrument Tubing
Same as for closed type transmitter rack. Refer 6.15.01 (o) above

6.15.03**Wiring of the Racks**

- (a) A fully enclosed IP 65 type junction box shall be provided in each rack for housing the terminal blocks connectors, power supply fuses and other electrical accessories, as required.
- (b) Junction boxes for modular enclosures shall be fabricated externally on one end of each enclosure assembly to accept field wiring/cabling through the top or bottom of the junction box. A hinged door shall give access to the interior of the junction box.
- (c) All electrical connections between instruments and the junction box terminal blocks shall be made. In addition all utility wiring for lighting and service power shall be installed.
- (d) All wiring used within the enclosures shall conform to NEC/ IEC standards. All wiring shall run through flexible or rigid conduits and shall be terminated at suitable terminal blocks. Sufficient clearance shall be provided for all control and instrument leads and all incoming and outgoing leads shall be connected to terminal blocks suitably located for connecting external circuits.
- (e) High impedance circuits shall be connected using shielded or coaxial wire suitable for the service.
- (f) Conduits shall be supported properly at regular intervals with suitable conduit clamps.
- (g) Wire shall be neatly arranged and routed/laid in PVC trough/tray.

6.15.04

In general, local Instrument enclosures & racks shall be designed considering above cl no. 6.04.00 to 6.14.00 and chapter 9, Vol. V.



APPLICABLE CODES AND STANDARDS

1.08.00 CODES AND STANDARDS

1.08.01 All equipments, system and service covered under this specification shall comply with the requirements of the latest statutes regulations and safety codes as applicable in the locality where the equipments/systems will be installed. The Bidder shall fully acquaint himself with these requirements and shall ensure compliance with them.

The equipments, systems and services furnished as per this specification shall conform to the codes and standards mentioned in Cl. no. 1.08.02 of this Section. However in the event of any conflict between the requirements of two standards or between the requirements of any standard and this specification, the more stringent requirements shall apply unless confirmed otherwise by the Owner in writing. The decision of the Owner shall be final and binding in all such cases.

The Bidder's scope of supply shall include some items such as thermowells, and other in-line devices for main steam, hot reheat, cold reheat, feed water system falling under the purview of Indian Boiler Regulation (IBR) Act. It shall be the responsibility of the Bidder to obtain the necessary approval of the concerned Inspecting Authority/Chief Inspector of Boilers for the design and design calculations and manufacturing and erection procedures as called for under the IBR act for all items requiring such certifications.

The requirements of statutory authorities (e.g. MOEF, Inspectors of factories, IBR, TAC, BEE, CPCB/TNPCB etc) with regards to various plants areas like Main plant, Fuel oil plant/system, Chlorination Plant, Fire Fighting system, Emission Measurement, Ambient Air Monitoring system etc. shall be complied, even if not actually spelt out.

1.08.02 Reference Codes and Standards

The design, manufacture, inspection, testing, site calibration and installation of all equipment and systems covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable ANSI,



ASME, IEEE, NEC, NEMA, ISA, DIN, VDE, NFPA, IEC, EIA, TIA and Indian Standards and their equivalents. Bidder to note that in no case, OEM/manufacturers own standards shall be accepted.

1.08.02.01 Temperature Measurement

1. Performance Test Code for temperature measurement ASME PTC 19.3 (1974 – R 1998)
2. Temperature measurement - Thermocouples ANSI-MC 96.1 – 1982, IEC 584
3. Temperature measurement by electrical resistance thermometers - IS-2806.
4. Thermometer-element-platinum resistance-IS-2848, IEC 751/DIN 43760
5. RTD Design Code – DIN EN 60751:1996, BS EN 60751 : 2008
6. Thermowell Design Code – ASME PTC 19.3 TW – 2010

1.08.02.02 Pressure Measurement

1. Performance Test Code for pressure measurement - ASME PTC 19.2 (2010)
2. Bourdon tube pressure and vacuum gauges - IS 3624, IS 3602, ASME B 40.1

1.08.02.03 Electronic measuring Instruments & Control hardware

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973), IS 9319
2. Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 - 1974.
3. Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1:ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975): ISA-S26 (1968).
5. Surge withstand capability (SWC) tests - ANSI C 37.90A (1974) IEEE Std. 472 (1974). IEC – 255.4.
6. Printed circuit boards - IPC TM-650, IEC 326 C
7. General requirements and tests for printed wiring boards - IS 7405 (Part-I) - 1973
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles ANSI C73-1973.
11. Direct acting Electrical Indicating Instruments: IS-1248-1968.

1.08.02.04 Instrument Switches and Contacts

1. Contact rating - AC services NEMA ICS Part-2 125, A600
2. Contact rating - DC services NEMA ICS Part-2-125, N600.



1.08.02.08 Control Valves

1. Control Valve sizing - Incompressible fluids - ISA S39.2 - 1972.
2. Control valve sizing - Compressible fluids - ISA S39.3 - 1973, ISA S39.4 - 1974.
3. Face to face dimensions of control valves - ANSI B16.10
- 1) ISA Hand book of control valves - ISBN B1047-087664-234-2.
- 2) Valves - flanged, threaded and welding end : ANSI B 16.34(2009)
- 3) Casting : ASTM A 216 / A 351 (2008)
- 4) Welded end connection : As per ASME boiler and pressure vessel code / ANSI.B 16.34(2009), B16.25 (2009), B 16.11(2009).
- 5) Defect removal: ANSI B 16.34 2009.
- 6) Cleaning : ASTM A 380 2006.
- 7) CV test : As per ISA procedure S 75.02 (2008).
- 8) Control Valve seat leakage : ANSI/FCI 70.2

1.08.02.09 Enclosures

1. Types of enclosures - NEMA Std. ICS-6-110.15 through 110.22 (Type 4 to 13).
2. Racks, panels, and associated equipment - EIA: RS-310-B (ANSI C83.9 - 1972)
3. Protection Class for Enclosure, Cabinets, Control Panels and Desks - IS-13947-1962.

1.08.02.10 Apparatus, enclosures and installation practices in hazardous areas

1. Classification of hazardous area - NFPA Art. 500, Vol.70-1984.
2. Electrical Instruments in hazardous dust locations - ISA-RP 12.11
3. Intrinsically safe apparatus - NFPA Art.493 Vol.4.1978
4. Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Art. 496 1982.



1.08.02.12 Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA RP 18.1-1979.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE std. 472-1974

1.08.02.13 Interlocks, Protections

1. Relays and relay system associated with electric power apparatus - IEEE std.3.13.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE Std. 472 - 1974.
3. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I) 1973.
4. Turbine water damage prevention - ASME - TDP-1980.
5. Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

1.08.02.14 Process Connection and Piping:

1. Codes for pressure piping power piping ANSI B31.1
2. Seamless carbon steel pipe ASTM A-106.
3. Forged and Rolled Alloy steel pipe flanges, forged fittings, valves and parts - ASTM A-182.
4. Material for socket welded fittings - ASTM A-105.
5. Seamless ferrite alloy steel pipe - ASTM A-335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM A-234.
7. Composition bronze or metal castings - ASTM B-62.
8. Seamless copper tube, bright annealed ASTM B-168.
9. Seamless copper tube - ASTM B-75.
10. Dimensions of fittings - ANSI B-16.11
11. Valves flanged and butt welding ends - ANSI B16.34.
12. Nomenclature for Instrument tube fittings ISA-RP-42.1 - 1982.

1.08.02.15 Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A106.
2. Material for socket weld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI B16.11
4. Code for pressure piping, welding, hydrostatic testing - ANSI B31.1.

1.08.02.16 Cables

1. Thermocouple extension wires/cables - ANSI C 96.1 - 1982.
2. Colour coding of single or multi-pair cables – VDE 0815



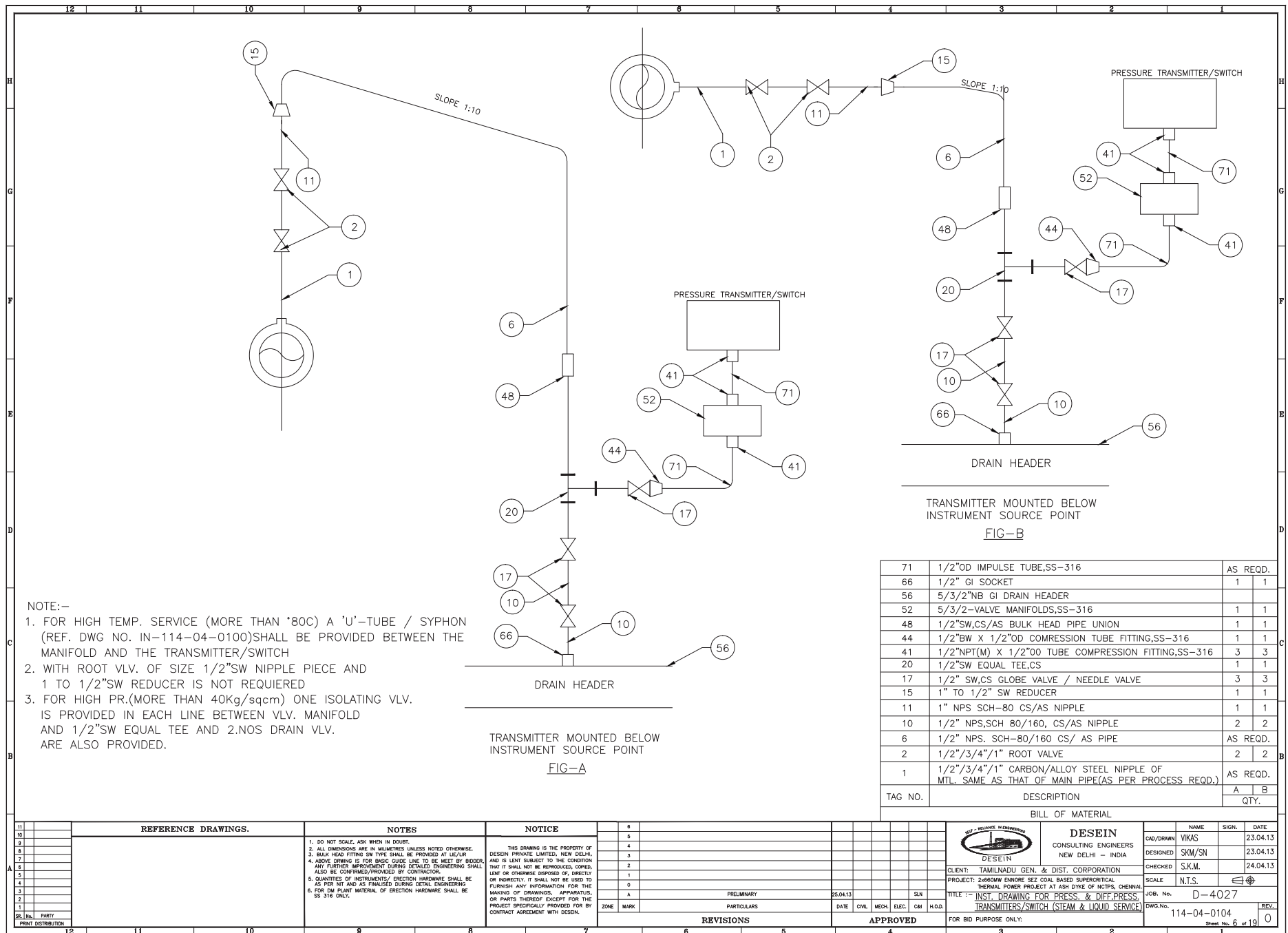
3. Guide for design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422 - 1977.
4. Requirements of vertical tray flame test - IEEE 383 - 1974.
5. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33 - 81.
6. Oxygen index and temperature index test - ASTM D-2863.
7. Smoke generation test - ASTM D-2843 and ASTM E-662.
8. Acid gas generation test - IEC-754-1.
9. Swedish chimney test - SEN - 4241475 (F3)
10. Instrumentation cables and internal wiring IS-1554 (Part-I, 1976) and IS-5831(1984).
11. Standard for Control, Thermocouple Extension and Instrumentation cable - NEMA WC57-2004 (IECA S-73-532, Rev. 2, 2004)□
12. PVC insulated (heavy duty) Electric cables for working voltages upto and including 1100V - IS:1554 (Part-I)
13. Conductors for insulated electric cables and flexible cords. - IS:8130
14. PVC insulation and sheath of electric cables - IS:5831
15. Mild steel wires, strips and tapes top armoring cables - IS:3975
16. Water Immersion Test - VDE 0815
17. Drums for electric cables - IS : 1048

1.08.02.18 Flow measurement

1. ASME Performance Test Code PTC-19.5 (2004), ISA RP3.2
2. BS 1042
3. ISO 5167

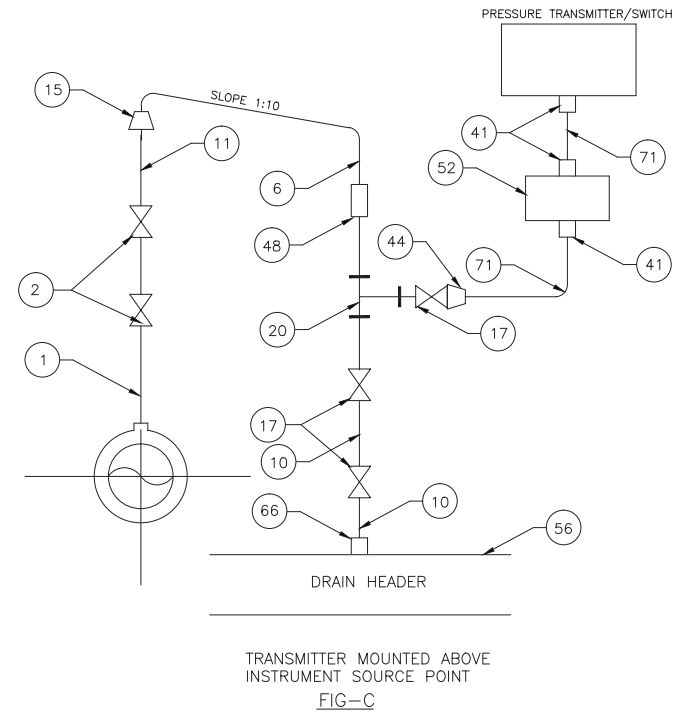
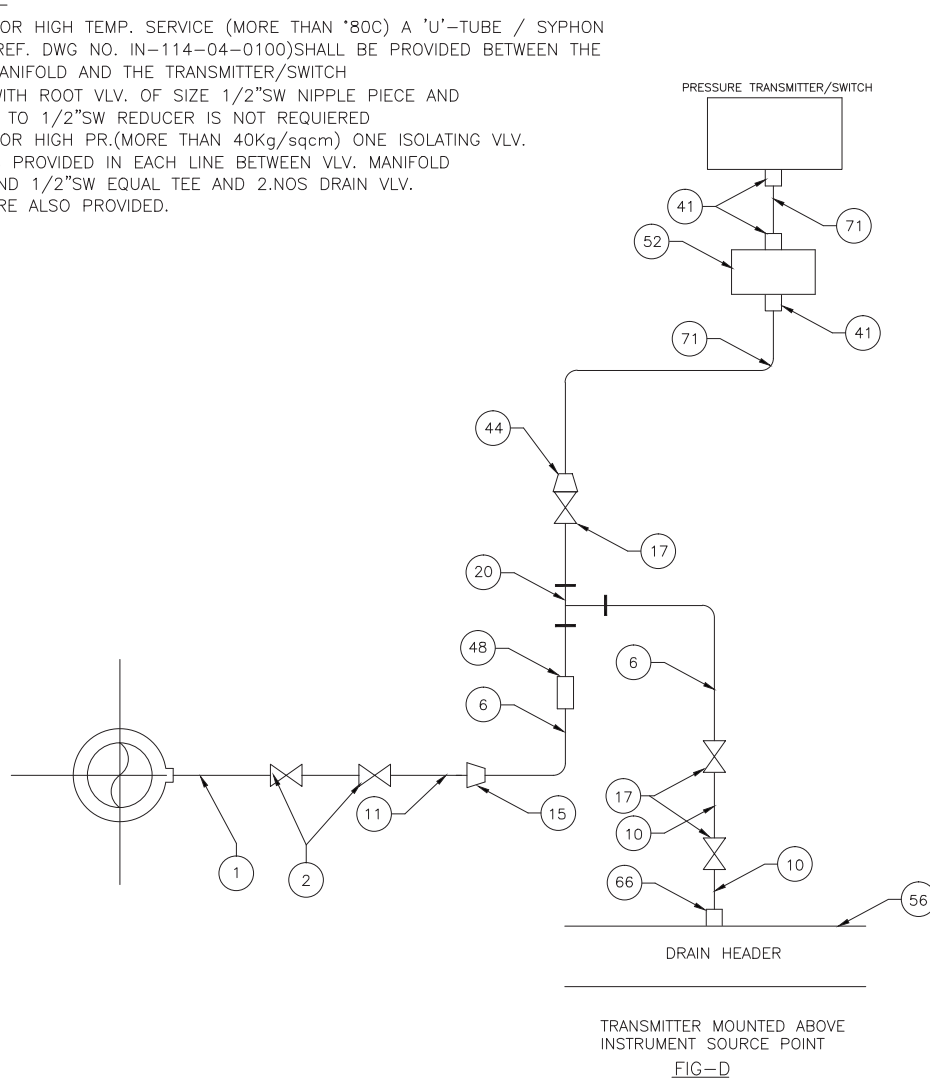


INSTRUMENT INSTALLATION DIAGRAM



NOTE:-

1. FOR HIGH TEMP. SERVICE (MORE THAN 80C) A 'U'-TUBE / SYPHON (REF. DWG NO. IN-114-04-0100) SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER/SWITCH
2. WITH ROOT VLV. OF SIZE 1/2"SW NIPPLE PIECE AND 1 TO 1/2"SW REDUCER IS NOT REQUIRED
3. FOR HIGH PR.(MORE THAN 40Kg/sqcm) ONE ISOLATING VLV. IS PROVIDED IN EACH LINE BETWEEN VLV. MANIFOLD AND 1/2"SW EQUAL TEE AND 2.NOS DRAIN VLV. ARE ALSO PROVIDED.



TAG NO.	DESCRIPTION	C	D	QTY.
71	1/2"OD IMPULSE TUBE,SS-316	AS REQD.		
66	1/2" GI SOCKET	1	1	
56	2"NB GI DRAIN HEADER			
52	5/3/2-VALVE MANIFOLDS,SS-316	1	1	
48	1/2"SW,CS/AS BULK HEAD PIPE UNION	1	1	
44	1/2"BW X 1/2"OD COMPRESSION TUBE FITTING,SS-316	1	1	
41	1/2"NPT(M) X 1/2"OD TUBE COMPRESSION FITTING,SS-316	3	3	
20	1/2"SW EQUAL TEE,CS	1	1	
17	1/2" SW,CS GLOBE VALVE / NEEDLE VALVE	3	3	
15	1" TO 1/2" SW REDUCER	1	1	
11	1" NPS SCH-80 CS/AS NIPPLE	1	1	
10	1/2" NPS,SCH 80/160, CS/AS NIPPLE	2	2	
6	1/2" NPS. SCH-80/160 CS/ AS PIPE	AS REQD.		
2	1/2"/3/4"/1" ROOT VALVE	2	2	
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.		

BILL OF MATERIAL			
NAME	SIGN.	DATE	
CAD/DRAWN	VIKAS	23.04.13	
DESIGNED	SKM/SN	23.04.13	
CHECKED	S.K.M.	24.04.13	
SCALE	N.T.S.		
JOB. No.	D-4027		
DWG.No.	114-04-0104		
Sheet No.	7 of 19		

CLIENT: TAMILNADU GEN. & DIST. CORPORATION
PROJECT: 2x600MW ENCORE SET COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DIKE OF NCTPS, CHENNAI
TITLE :- INST. DRAWING FOR PRESS. & DIFF.PRESS. TRANSMITTERS/SWITCH (STEAM & LIQUID SERVICE)
FOR BID PURPOSE ONLY:

PRELIMINARY
25.04.13
DATE
CIVIL MECH. ELEC. CM H.O.D.

APPROVED

REVISIONS

ZONE MARK

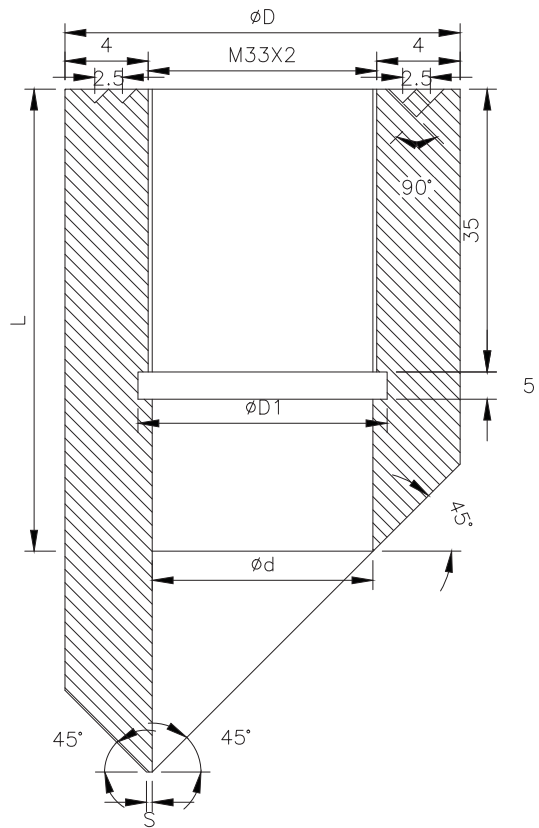
NOTES

NOTICE

REFERENCE DRAWINGS.

PRINT DISTRIBUTION

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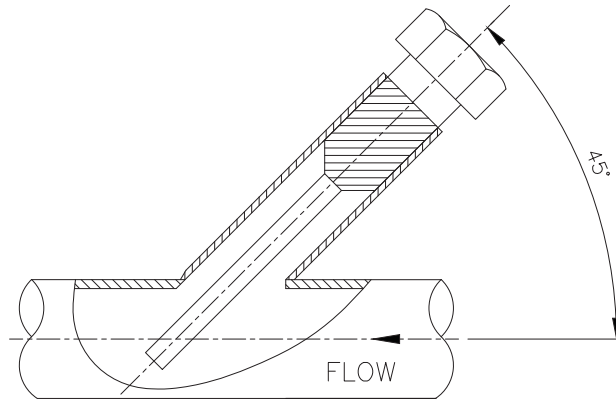


TEMPERATURE STUB FOR SLANT IMMERSION

FOR PIPE OD BELOW 219.1mm	29	55	33.5	1.5	65
FOR PIPE OD 219.1mm & ABOVE	29	55	33.5	1.5	45
MAIN PIPE SIZES	d	D	D1	S	L

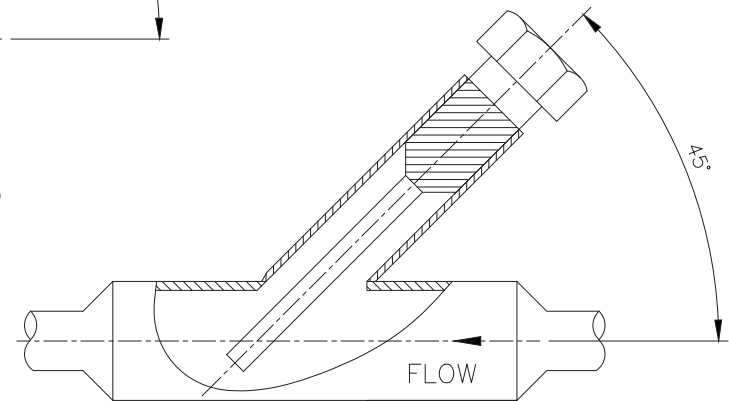
NOTE :-

1. MATERIAL OF THE BOSS SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED.
2. LENGTH OF THE STUB (L) SHALL BE 65/45 mm DEPENDING UPON PIPE SIZE, AS PER CORPORATE STD. AA 7326102.(FOR PIPE OD 88.9mm TO 159mm STUB HEIGHT SHALL BE=65mm & FOR PIPE OD >219.1mm STUB HEIGHT SHALL BE=45mm)
3. STRAIGHT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 168.3mm & ABOVE.
THE STUB HEIGHT FOR PIPE OD, 168.3mm TO <219.1mm SHALL BE 65mm.
4. SLANT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 88.9mm TO 159mm.
5. FOR MAIN PIPE OD'S 88.9mm & BELOW SUITABLE EXPANDER SHALL BE USED.



INSTALLATION TYPE-3

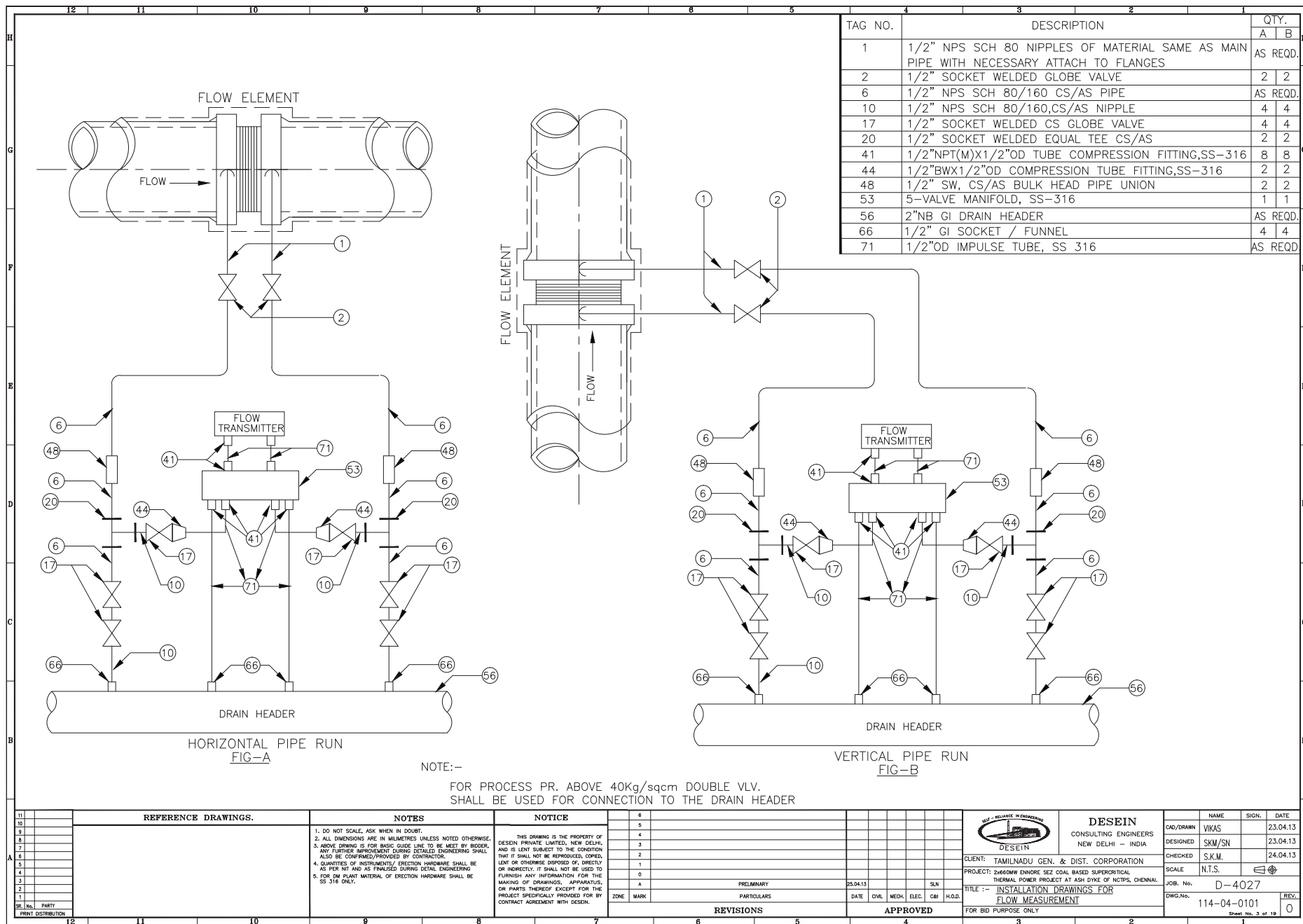
(FOR MAIN PIPE OD 88.9mm TO 159mm)

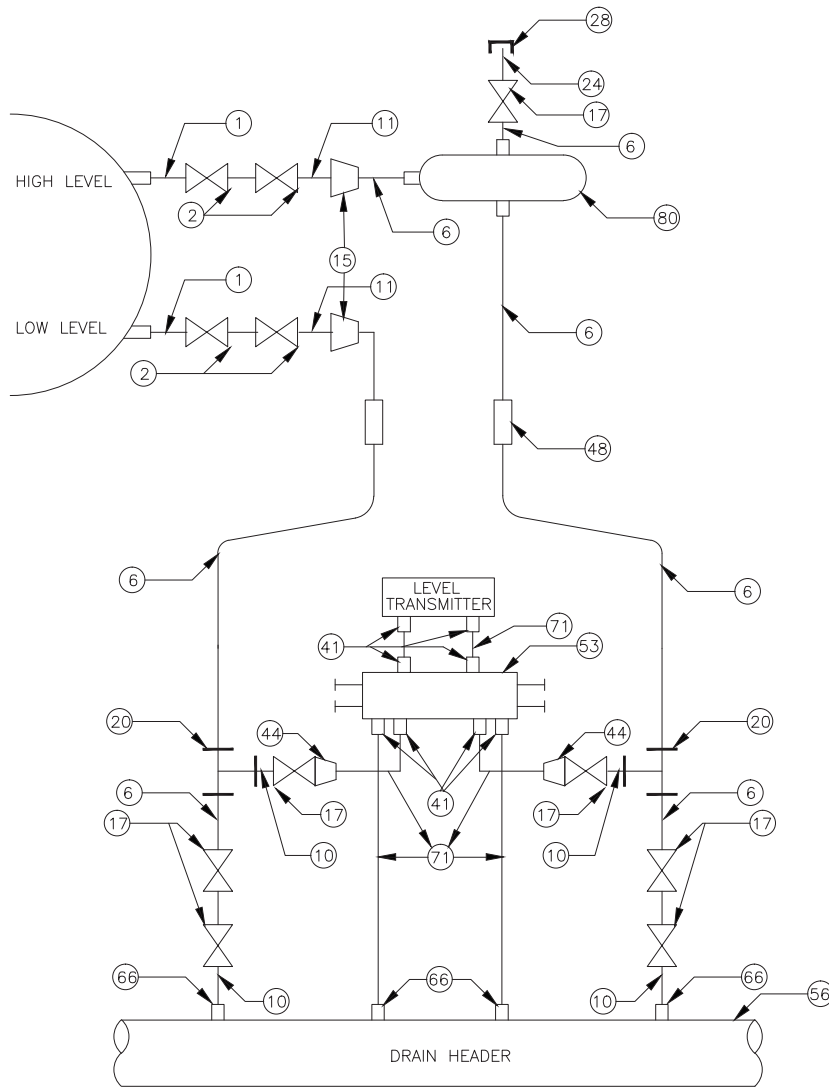


INSTALLATION TYPE-4

(FOR MAIN PIPE OD 88.9mm & BELOW)

11	10	9	8	7	6	5	4	3	2	1
11	10	9	8	7	6	5	4	3	2	1
10	9	8	7	6	5	4	3	2	1	
9	8	7	6	5	4	3	2	1		
8	7	6	5	4	3	2	1			
7	6	5	4	3	2	1				
6	5	4	3	2	1					
5	4	3	2	1						
4	3	2	1							
3	2	1								
2	1									
1										
10	9	8	7	6	5	4	3	2	1	
9	8	7	6	5	4	3	2	1		
8	7	6	5	4	3	2	1			
7	6	5	4	3	2	1				
6	5	4	3	2	1					
5	4	3	2	1						
4	3	2	1							
3	2	1								
2	1									
1										
10	9	8	7	6	5	4	3	2	1	
9	8	7	6	5	4	3	2	1		
8	7	6	5	4	3	2	1			
7	6	5	4	3	2	1				
6	5	4	3	2	1					
5	4	3	2	1						





TRANSMITTER MOUNTED BELOW INST. SOURCE POINT

TAG NO.	DESCRIPTION	BOM
80	CONDENSATION CHAMBER	1
71	1/2"OD IMPULSE TUBE, SS-316	AS REQD.
66	1/2" GI SOCKET / FUNNEL	4
56	2"NB GI DRAIN HEADER	AS REQD.
53	5-VALVE MANIFOLD, SS-316	1
48	1/2" SW, CS/AS BULK HEAD PIPE UNION	2
44	1/2"BX1/2"OD COMPRESSION TUBE FITTING,SS-316	2
41	1/2"NPT(M)X1/2"OD TUBE COMPRESSION FITTING,SS-316	8
28	1/2" NPT (F) CS CAP	1
24	1/2" NPS SCH-80/160X1/2"NPT(M) CS/AS NIPPLE	1
20	1/2" SOCKET WELDED EQUAL TEE CS/AS	2
17	1/2" SOCKET WELDED CS GLOBE VALVE	7
15	1"TO 1/2" SOCKET WELD REDUCER	2
11	1" NPS SCH 80/160 CS/AS NIPPLE	2
10	1/2" NPS SCH 80/160,CS/AS NIPPLE	4
6	1/2" NPS SCH 80/160 CS/AS PIPE	AS REQD.
2	1/2"/3/4"/1" SOCKET WELDED GLOBE VLV/ROOT VLV.	4
1	1/2" NPS SCH 80 NIPPLES OF MATERIAL SAME AS MAIN PIPE WITH NECESSARY ATTACH TO FLANGES	AS REQD.

NOTE:-

- FOR HIGH TEMP. SERVICE (MORE THAN 80°C) A 'U' TUBE(REF. DWG NO. 114-04-0100) SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER
- FOR HIGH PR.(MORE THAN 40kg/sqcm) ONE NO. OF ISOLATING VLV. IS PROVIDED IN EACH LINE BETWEEN VLV. MANIFOLD AND 1/2"SW EQUAL TEE AND 2NO. DRAIN VLV. ARE ALSO

REFERENCE DRAWINGS.		NOTES		NOTICE		REVISIONS		APPROVED		FOR BID PURPOSE ONLY:	
11		1. DO NOT SCALE, ASK WHEN IN DOUBT.		THIS DRAWING IS THE PROPERTY OF DESEIN PRIVATE LIMITED, NEW DELHI, AND IS LENT SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF, DIRECTLY OR INDIRECTLY. IT SHALL NOT BE USED TO FURNISH ANY INFORMATION FOR THE MAKING OF DRAWINGS, APPARATUS, OR PARTS THEREOF EXCEPT FOR THE PROJECT SPECIFICALLY PROVIDED FOR BY CONTRACT AGREEMENT WITH DESEIN.		6					
10		2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.				5					
9		3. BULK HEAD FITTING SW TYPE SHALL BE PROVIDED AT USER'S				4					
8		4. ABOVE DRAWING IS FOR BASIC GUIDE LINE TO BE MET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.				3					
7		5. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER INT. AND AS FINALISED DURING DETAIL ENGINEERING				2					
6		6. FOR CM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.				1					
5						0					
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1											
SR. No. PARTY		PRINT DISTRIBUTION				DATE		CIVIL MECH. ELEC. CM H.O.D.		JOB No.	
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										114-04-0110	
										Sheet No. 13 of 19	

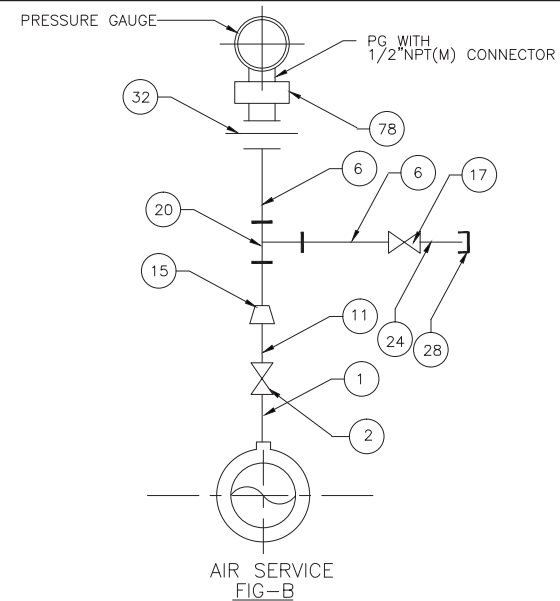
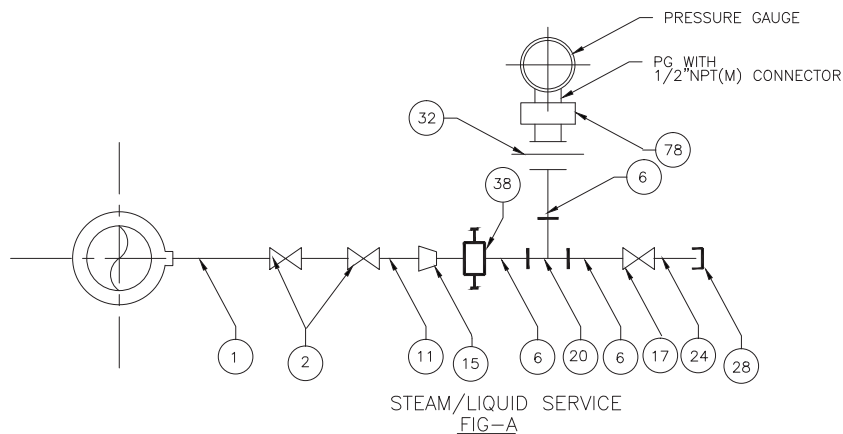


DESEIN
CONSULTING ENGINEERS
NEW DELHI - INDIA

NAME	SGN.	DATE
CAD/DRAWN VIKAS		23.04.13
DESIGNED SKM/SN		23.04.13
CHECKED SKM.		24.04.13

CLIENT: TAMILNADU GEN. & DIST. CORPORATION
PROJECT: 2x660MW ENHANCE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI.
TITLE :- INST. DRAWING FOR LEVEL TRANSMITTERS

SCALE	N.T.S.
DWG.No.	114-04-0110
REV.	0



78	1/2"NPT(F)X1/2"NPT(M) SNUBBER/PULSATION DAMPER	1	1
59	1/2"SW, STRAIGHT PIPE CONNECTOR, CS/AS	—	—
38	3 WAY GAUGE VALVE 1/2" NB SW	1	—
37	6" COILED SYPHON SCH 80/160 1/2"NB CS/SS	—	—
32	1/2"NPS,3PIECE PIPE UNION WITH 1/2"NPT(F) SCREWED	1	1
28	1/2"NPT (F) CS CAP	1	1
24	1/2"NPS,SCH-80/160X1/2"NPT(M)CS/AS NIPPLE	1	1
20	1/2"SW EQUAL TEE, CS/AS	1	1
17	1/2" SW CS/AS GLOBE VALVE	1	1
15	1" TO 1/2" SOCKET WELDED REDUCER	1	1
11	1" NPS SCH-80/160 CS/AS NIPPLE	1	1
6	1/2" NPS. SCH-80/160 CS/ AS PIPE	AS REQD.	
2	1/2"/3/4"/1" ROOT VALVE-SW GLOBE VALVE	2	1
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.	
TAG NO.	DESCRIPTION	A	B
		QTY.	
BILL OF MATERIAL			

REFERENCE DRAWINGS. 11. _____ 10. _____ 9. _____ 8. _____ 7. _____ 6. _____ 5. _____ 4. _____ 3. _____ 2. _____ 1. _____		NOTES 1. DO NOT SCALE, ASK WHEN IN DOUBT. 2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE. 3. ABOVE DRAWING IS FOR BASIC GUIDE LINE TO BE MET BY ROOOF. ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR. 4. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER INT AND AS FINALISED DURING DETAIL ENGINEERING. 5. PRESSURE GAUGE SHALL BE PROVIDED WITH SS-316. 6. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.		NOTICE THIS DRAWING IS THE PROPERTY OF DESEIN PRIVATE LIMITED, NEW DELHI, AND IS LENT SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF DIRECTLY OR INDIRECTLY. IT SHALL NOT BE USED TO FURNISH ANY INFORMATION FOR THE MAKING OF DRAWINGS, APPARATUS, OR PARTS THEREOF EXCEPT FOR THE PROJECT SPECIFICALLY PROVIDED FOR BY CONTRACT AGREEMENT WITH DESEIN.		REVISIONS <table border="1"> <tr> <th>NO.</th> <th>DATE</th> <th>BY</th> <th>REASON</th> </tr> <tr> <td>1</td> <td>23.04.13</td> <td>SKM</td> <td>PRELIMINARY</td> </tr> </table>		NO.	DATE	BY	REASON	1	23.04.13	SKM	PRELIMINARY	APPROVED <table border="1"> <tr> <th>DATE</th> <th>CIVIL</th> <th>MECH.</th> <th>ELEC.</th> <th>CMJ</th> <th>H.O.D.</th> </tr> <tr> <td>23.04.13</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>		DATE	CIVIL	MECH.	ELEC.	CMJ	H.O.D.	23.04.13						 DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA CLIENT: TAMILNADU GEN. & DIST. CORPORATION PROJECT: 2x660MW DANORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DIKE OF NCTPS, CHENNAI. TITLE :- INST. DRAWING FOR LOCAL PRESSURE GAUGE FOR BID PURPOSE ONLY		<table border="1"> <tr> <th>NAME</th> <th>SIGN.</th> <th>DATE</th> </tr> <tr> <td>VIKAS</td> <td></td> <td>23.04.13</td> </tr> <tr> <td>SKM/SN</td> <td></td> <td>23.04.13</td> </tr> <tr> <td>S.K.M.</td> <td></td> <td>24.04.13</td> </tr> </table> SCALE: N.T.S. JOB. No. D-4027 DWG.No. 114-04-0106 REV. 0 Sheet No. 9 of 10		NAME	SIGN.	DATE	VIKAS		23.04.13	SKM/SN		23.04.13	S.K.M.		24.04.13
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