LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT			
Sl. No.	**DRAWING NO.**	**DRAWING/DOCUMENT TITLE**	**CATEGORY**
1	PE-V0-445-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM WITH SET POINTS	A
2	PE-V0-445-145-I902	CONTROL SCHEME/LOGIC DIAGRAM (TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V0-445-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V0-445-145-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5	PE-V0-445-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V0-445-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V0-445-145-I907	FIELD JB/LIE/LIR,DRIVES TERMINATIONS	A
8	PE-V0-445-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V0-445-145-I909	QUALITY PLANS (INSTRUMENTS, VMS, etc.)	A
10	PE-V0-445-145-I910	INSTRUMENT HOOK-UP DRAWING	A
11	PE-V0-445-145-I911	THERMOWELL SIZING CALCULATION	A
12	PE-V0-445-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
13	PE-V0-445-145-I914	ANNUNCIATION & SOE LIST	A

NOTES:
ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

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.

MOTORISED VALVE ACTUATOR

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	DOCUMENT NO.: PE-ID-445-145-I902 VOLUME II B SECTION D REV. NO. 01 DATE:27/03/2020 SHEET 1 OF 5

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL*	* PROJECT	**1 X 660 MW SAGARDIGHI STPP**		
	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 -20 to70 DEG C AND RELATIVE HUMIDITY OF 0-95%IN HOT HUMID AND TROPICAL ATMOSPHERE AND HIGHLY POLLUTED AT PLACES OF COAL DUST AND FLY DUST		
	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, DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, NEMA6/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 as per IEC60034-1**		
HANDWHEEL as per standard EN 12570:2000	* 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) (REFER NOTE NO. 6 & 7)	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) ☐ ..... ■TO BE DECIDED DURING DETAILED ENGINEERING		
	PAINT TYPE	☐ ENAMEL ■ EPOXY CONFIRMING TO CORROSION CATEGORY C5-I		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	DOCUMENT NO.: PE-ID-445-145-I902
		VOLUME II B
		SECTION D
		REV. NO. 01 DATE:27/03/2020
		SHEET 2 OF 5

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ 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	
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ■IP 68 ☐ FLAME PROOF	
	@MOTOR BEARING WITH 2 EARTH TERMINALS	DOUBLE SHIELDED; GREASE LUBRICATED ANTI FRICTION	
	@ 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 (THERMISTOR PTC)	
INTEGRAL STARTER	INTEGRAL STARTER	■REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	■ CONTACTORS ☐ THYRISTORS	
	TYPE	■ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	IF SMART (REFER BELOW POINT a – h)		
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐.....	
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC	
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....	
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP	
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	■ REQUIRED	
	OPEN / CLOSE PB	■REQUIRED ☐ NOT REQUIRED	
	STOP PB	■ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	■ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	■REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	■REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL(Refer Note 14)	REQUIRED MOTOR THERMOSTSTTRIP O/L RELAY OPTD, CONT./POWER SUPPLY FAILED, S/S IN LOCAL/REMOTE/OFF MODE, TORQUE SWITCH OPEN/CLOSE CUT OFF/STOP PB OPTD, VALVE JAMMED ETC)	
	ACTION ON LOSS OF EXTERNAL ELECTRIC POWER	■STAYPUT ■ FAIL SAFE TO BE DECIDED DURING DETAILED ENGINEERING	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter) **DATASHEET & WIRING DIAGRAM OF ISOLATION DEVICE TO BE PROVIDED**	TYPE OF ISOLATING DEVICE	■ INTERPOSING RELAY ☐ OPTO COUPLER TO BE DECIDED DURING DETAILED ENGINEERING	
	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	

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	DOCUMENT NO.: PE-ID-445-145-I902	
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Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
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	
	ACCURACY	2% OF SET VALUE	
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications**)	■ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ■ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	■ 24V DC ☐	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ■ IP 68 @☐.....	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET	☐ REQUIRED ■ NOT REQUIRED	
	NO. OF PINS REQUIRED(TO BE CHECKED AS PER SIGNALS IN DRIVE CONTROL PHILOSOPHY)		
	NOS. OF PLUG & SOCKET	☐ 1 Nos. for ON/OFF ☐ 2 NOS.(for inching duty) ☐ OTHER (TO BE SPECIFIED INLINE WITH DRIVE CONTROL PHILOSOPHY)	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:----------	
	@ SPACE HEATER CABLE GLAND	SIZE:----------	
	CONTROL CABLE GLANDS-1	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 4P X 1.5 SQMM	
	CONTROL CABLE GLANDS-2	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 8P X 0.5 SQMM	
	CONTROL CABLE GLANDS-3 (Additional for inching duty)	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 2P X 0.5 SQMM	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

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Data Sheet A & B

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

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
   IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691, IS-4722, IEC 60947-5-1 AND EN 15714-3 :2010 OR LATEST VERSION.
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
7. THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE RUNNING AT 80 PERCENT OF RATED VOLTAGE AT RATED TORQUE AND 85 PERCENT RATED VOLTAGE AT 33 PERCENT EXCESS RATED TORQUE FOR A PERIOD OF 5 MINUTES EACH.
8. IN ADDITION TO ABOVE REQUIREMENTS FOR LIMIT/TORQUE SWITCH, **MECHANICAL END STOP** WITH ACCURACY OF 2% SHALL BE SUPPLIED.
9. IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.
10. LOCAL POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL.
11. CONTROL WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM.
12. ENDURANCE: RATED TORQUE RANGE SHOULD BE BASED ON ISO 5211, ISO5210.
13. TAG PLATE SHALL BE CONFIRMING TO STANDARD BS-15714.
14. THE ACTUATORS SHALL BE DESIGNED TO BE SELF-LOCKING UPON LOSS OF POWER. MOTOR SHALL BE DESIGNED TO CLOSE IN 30 SECS. FROM FULL OPEN POSITION AND SHALL HAVE ADEQUATE CAPACITY TO OPEN AND CLOSE UNDER FULL UNBALANCED DESIGN PRESSURE.
15. AUTOMATIC PHASE CORRECTION FACILITY AND POTENTIAL FREE CONTACT FOR ANNUNCIATION OF POWER FAILURE SHALL BE PROVIDED.
16. LIMIT SWITCHES SHALL BE SILVER PLATED WITH HIGH CONDUCTIVITY AND NON-CORROSIVE TYPE. CONTACT RATING SHALL BE SUFFICIENT TO MEET THE REQUIREMENT OF CONTROL SYSTEM SUBJECT TO A MINIMUM OF 60 V, 6 VA RATING. PROTECTION CLASS SHALL BE IP67.
17. THE TERMINAL BOX SHALL BE WEATHER PROOF WITH REMOVABLE FRONT COVER & CABLE GLANDS FOR CABLE CONNECTION.IT SHALL BE SUITABLE FOR 2.5 SQ MM COPPER CONDUCTOR.
18. ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
19. **** VALVES WITH 10 DEGREE/20DEGREE FEEDBACK REQUIREMENT FOR APPLICATIONS SUCH AS CW/ACW/PLANT WATER SYSTEM SHALL BE CONSIDERED AS INCHING DUTY VALVES. ACCORDINGLY, POSITION FEED BACK TRANSMITTER, PLUG & SOCKET REQUIREMENT SHALL BE CONSIDERED.**

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

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME	ANJALI RAMAN	VIPUL KUMAR VERMA	SURESH CHAND SHARMA	NAME
SIGNATURE				SIGNATURE
DATE	27.03.2020	27.03.2020	27.03.2020	DATE

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

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	DOCUMENT NO.: PE-ID-445-145-I902		
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Data Sheet A & B

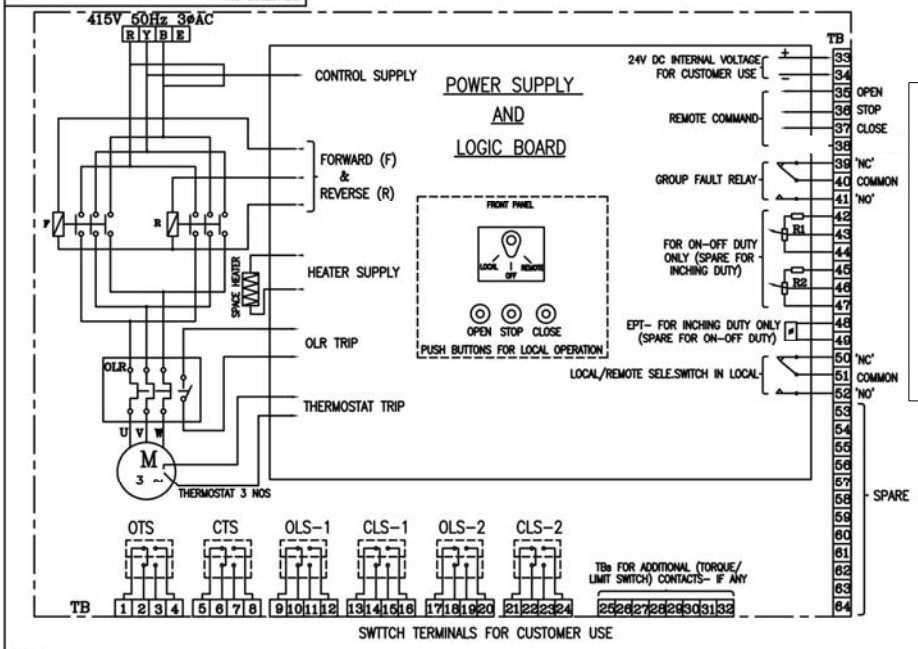
DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

ADDITONAL NOTES FOR SAGARDIGHI PROJECT:

- TEST WITNESS: TESTS SHALL BE PERFORMED IN THE PRESENCE OF OWNER/PURCHASER'S REPRESENTATIVE SO DESIRED BY THE OWNER/ PURCHASER. THE CONTRACTOR SHALL GIVE AT LEAST FIFTEEN (15) DAYS ADVANCE NOTICE OF THE DATE WHEN THE TESTS ARE TO BE CARRIED OUT.
- ADVANCE NOTICE SHALL BE GIVEN TO THE OWNER AS AGREED IN THE CONTRACT, PRIOR TO THE STAGE OF MANUFACTURE BEING REACHED, AND THE PIECE OF PLANT MUST BE HELD AT THIS STAGE UNTIL THE OWNER HAS INSPECTED THE PIECE, OR HAS ADVISED IN WRITING THAT INSPECTION IS WAIVED, IF HAVING CONSULTED THE OWNER AND GIVEN REASONABLE NOTICE IN WRITING OF THE DATE ON WHICH THE PIECE OF PLANT WILL BE AVAILABLE FOR INSPECTION, THE OWNER DOES NOT ATTEND, THE SUCCESSFUL BIDDER MAY PROCEED WITH MANUFACTURE HAVING FORWARDED TO THE OWNER DULY CERTIFIED COPIES OF HIS OWN INSPECTION AND TEST RESULTS.
- ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
- A SPACE HEATER SHALL BE INCLUDED IN THE LIMIT SWITCH COMPARTMENT SUITABLE FOR 240V, 1 PHASE, 50 HZ SUPPLY.

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

DRAWING NO. 3-V-MISC-24227



Separate wire (no common wire) to be used for signal exchange between DCS and actuator. Additionally, separate TBs are to be used at actuator end. Please refer attached dwg 12A05-DWG-I0021 for the same.

CONTACT DEVELOPMENT DIAGRAM

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

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

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

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

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

- CLS NOT TO BE CONNECTED IN TRIP CIRCUIT
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

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

REV	DATE	ALTERED
		CHD & APPD

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

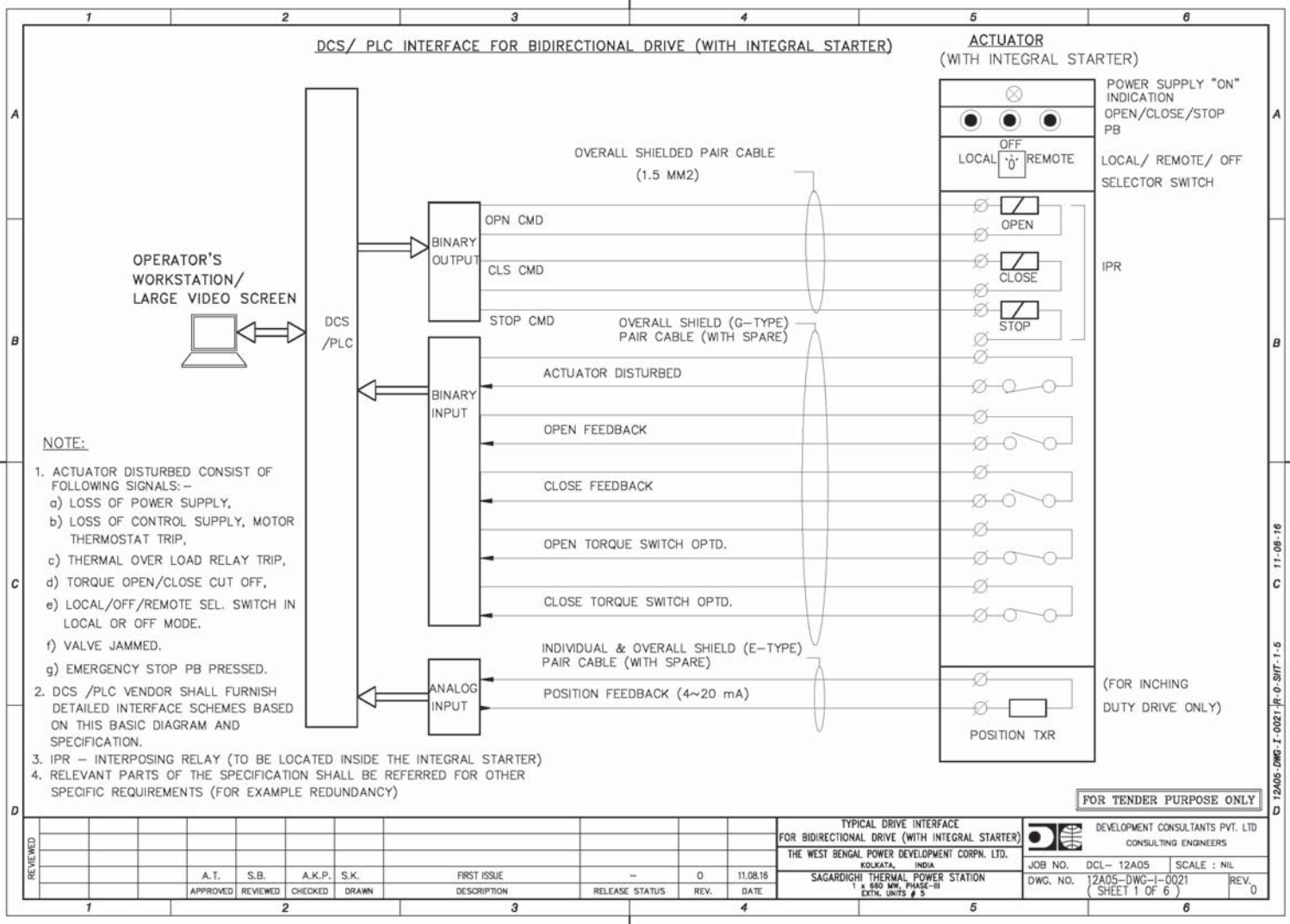
BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT. TIRUCHIRAPALLI-620014. 365-121

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

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

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER | CARD CODE U 01 | DRAWING NO. 3-V-MISC-24227 | REV 0

Size A3


DCS/ PLC INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)
ACTUATOR
(WITH INTEGRAL STARTER)
OPERATOR'S WORKSTATION/ LARGE VIDEO SCREEN
DCS /PLC
BINARY OUTPUT
BINARY INPUT
ANALOG INPUT
OPN CMD
CLS CMD
STOP CMD
OVERALL SHIELDED PAIR CABLE (1.5 MM2)
OVERALL SHIELD (G-TYPE) PAIR CABLE (WITH SPARE)
INDIVIDUAL & OVERALL SHIELD (E-TYPE) PAIR CABLE (WITH SPARE)
ACTUATOR DISTURBED
OPEN FEEDBACK
CLOSE FEEDBACK
OPEN TORQUE SWITCH OPTD.
CLOSE TORQUE SWITCH OPTD.
POSITION FEEDBACK (4~20 mA)
POWER SUPPLY "ON" INDICATION
OPEN/CLOSE/STOP PB
OFF
LOCAL
REMOTE
LOCAL/ REMOTE/ OFF SELECTOR SWITCH
OPEN
CLOSE
STOP
IPR
POSITION TXR
(FOR INCHING DUTY DRIVE ONLY)
NOTE:
1. ACTUATOR DISTURBED CONSIST OF FOLLOWING SIGNALS:-
a) LOSS OF POWER SUPPLY,
b) LOSS OF CONTROL SUPPLY, MOTOR THERMOSTAT TRIP,
c) THERMAL OVER LOAD RELAY TRIP,
d) TORQUE OPEN/CLOSE CUT OFF,
e) LOCAL/OFF/REMOTE SEL. SWITCH IN LOCAL OR OFF MODE.
f) VALVE JAMMED.
g) EMERGENCY STOP PB PRESSED.
2. DCS /PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. IPR - INTERPOSING RELAY (TO BE LOCATED INSIDE THE INTEGRAL STARTER)
4. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIREMENTS (FOR EXAMPLE REDUNDANCY)
FOR TENDER PURPOSE ONLY
REVIEWED
A.T. APPROVED
S.B. REVIEWED
A.K.P. CHECKED
S.K. DRAWN
FIRST ISSUE
DESCRIPTION
-
RELEASE STATUS
0
REV.
11.08.16
DATE
TYPICAL DRIVE INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA
SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
JOB NO. DCL- 12A05
SCALE : NIL
DWG. NO. 12A05-DWG-I-0021 (SHEET 1 OF 6)
REV. 0
12A05-DWG-I-0021-R-0-SHT-1-5
11-08-16
A3 (9-96) [420x297]

SECTION – III

ELECTRIC MOTOR ACTUATORS

1.00.00 **SCOPE**

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 **CODES & STANDARDS**

2.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian standards (IS), IEC, ANSI & NEMA. Standards except when otherwise stated herein or in the driven equipment specification.

2.02.00 Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case the seller shall provide details of how his standards comply with the Buyer's requirement and duly certified copies of the English version of the standard adopted shall be submitted.

3.00.00 **SERVICE CONDITIONS**

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

4.00.00 **RATING**

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or minimum S2-15 minutes as per IEC-60034-1, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operations before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

6.01.01 The actuator shall essentially comprise the drive motor, torque & limit switches, gear train, self locking features, clutch, hand wheel, position indicator & transmitter, in-built thermostat for over load protection, space heater and internal wiring.

6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.01.05 All motorized actuators shall be Smart Type and shall be furnished with Integral Starter mounted on the actuator and compatible with DCS/PLC. The Integral Starter shall be complete with:

1. One (1) triple pole breaker
2. One (1) no. reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC aux. contacts for each contactor.
3. One (1) no. Remote- Local selector switch
4. CLOSE-STOP-OPEN oil tight push buttons with indication lights. STOP push button shall be latchable type.
5. 415 / 240 V control transformer with primary and secondary fuses.

These actuators shall have diagnostic feature with valve checking facility from remote.

6.02.00 **Motor**

6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class F insulation and weatherproof IPW-55 enclosure, designed for high torque and reversing service.

6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

6.02.04 Earthing terminals shall be provided on either side of the motor.

6.03.00 **Limit Switches**

Each actuator shall be provided with following limit switches: -

6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.

6.03.02 4 end-of-travel limit switches, two for each direction of travel.

6.03.03 Open / Close command termination logic with position and torque limit switch positioner circuitry shall be suitably built in a PCB inside the actuator.

a) For binary drive, open/close/stop command and status thereof and disturbance monitoring signal (common contact for overload, thermostat, control supply failure, L/R selector switch at local, other protections operated) shall be provided.

Interface with the control system shall be through hardwired signal only. Interposing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system.

b) For modulating drive, the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided

c) Open/close command termination logic shall be suitably built inside actuator.

6.03.04 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.

6.03.05 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.

6.04.00 **Hand Wheel**

Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.

6.05.00 **Position Indicator/Transmitter (applicable for inching services only)**

The actuator shall have:

6.05.01 One (1) built-in local position indicator for 0-100% travel.

6.05.02 One (1) no. transducer (4-20 ma) for remote position indicator for 0-100 % travel

6.06.00 **Space Heater**

A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.

6.07.00 **Wiring**

All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules.

6.08.00 **Terminal Box**

The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2X2.5 Sq.mm copper conductors.

7.00.00 **TEST**

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

FIELD & MEASURING INSTRUMENTS

SECTION-VI

TECHNICAL SPECIFICATION

CONTROL AND INSTRUMENTATION SYSTEMS

1.00.00 FIELD INSTRUMENTS

This section provides general guidelines for field instruments and equipment to be supplied under this specification. All measuring instruments/equipment and subsystems offered by Bidder shall be from reputed experienced manufacturer of specified type and range of equipment, whose guaranteed and trouble free operation has been established. All instruments/equipment shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance and comply with the acceptable international standards. All instruments/equipment and accessories shall be supplied as per technical specifications, ranges, make as approved by Owner.

i) HART management system shall be integral feature of the DDCMIS and shall be provided for centralised configuration, maintenance, diagnostics & record-keeping for all electronic transmitters.

ii) Bidder shall provide following facilities as a minimum through software:

a) Constant scanning to monitor faults of changes to instrument configuration.

b) Owner-defined and standard calibration and configuration procedures for all transmitters.

c) Constant signal data collection facilities to maintain continuously updated records.

d) Automatic tracking of configuration changes made in the field, such as may be introduced by hand-held communicator. All configuration function associated with hand-held communicators shall be available in the system.

e) Event and log reports on screen as well as on printer.

f) Any addition/deletion of transmitter will be reported on printer and logged in hard disk.

1.01.00 PRESSURE TRANSMITTER

01.	Type	:	Microprocessor based Smart, HART protocol compatible
02.	Transmission	:	2 - Wire

03.	Output Signal	:	Simultaneous transmission of digital and 4-20 mA DC signal.
04.	Signal Processing	:	Silicon solid state electronic circuitry
05.	Sensor type	:	Capsule / Diaphragm
06.	Element material	:	AISI-316 or better
07.	Static Pressure	:	150 % of maximum span continuously, without affecting the calibration.
08.	Turn-down ratio	:	10 : 1 for vacuum/very low pressure application ; 30 : 1 minimum for other applications.
09.	Span and Zero	:	Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span
10.	Enclosure Class	:	Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required)
11.	Output Indicator	:	Backlit LCD type
12.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
13.	Body	:	Forged Carbon Steel (SS for DM Water & corrisve service).
14.	Power supply	:	16 - 48 Volts D.C.
15.	Load	:	500 Ohms (min.) at 24 Volts D.C.
16.	Ambient Temperature	:	0 - 50^{O}C
17.	Performance :		
i)	Accuracy	:	$\pm$ 0.075% of Span or better
ii)	Repeatability	:	$\pm$ 0.05% of Span or better
iii)	Response time	:	100 msec or better
iv)	Stability	:	$\pm$ 0.1% of Calibrated Span for 6 months up to 70 Kg/cm2 and $\pm$ 0.25% of Calibrated Span for more than 70 Kg/cm2
v)	Zero and span drift	:	$\pm$ 0.015% per deg. C at max span and 0.11% per deg. C at min span
18.	Sealing/Isolation	:	Extended diaphragm with 5 meters SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator

diaphragm shall be as per application. 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

19. Diagnostics : Self indicating feature

20. Accessories :
a) Universal mounting bracket suitable for 2" pipe mounting.
b) High tensile carbon steel U- bolts.
c) Installation accessories as per relevant installation drawing.
d) Syphons for steam and hot water services.
e) ½" NPT 2-valve stainless steel manifold for pressure transmitters constructed from SS316 bar stock. In case it becomes necessary to use a DP transmitter for gauge pressure measurement then a 2-valve manifold should be used in place of 5-valve manifold.
f) Companion flange with nuts, bolts and gaskets.
g) Hand held configurator kit for calibration of Smart Transmitter.

1.02.00 Differential Pressure Transmitter

01. Type : Microprocessor based Smart, HART protocol compatible

02. Transmission : 2-Wire

03. Output signal : Simultaneous transmission of digital and 4-20 mA DC signal.

04. Signal Processing Unit : Silicon solid-state electronic circuitry

05. Sensor type : Capsule/Diaphragm

06. Element material : AISI-316 (Stainless Steel) or better

07. Static Pressure/

Overload Pressure		:	Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
08.	Turn-down ratio	:	10 :1for vacuum/very low pressure application; 30 : 1 minimum for other applications.
09.	Span and Zero	:	Locally adjustable, non-interacting
10.	Enclosure class	:	Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required))
11.	Zero suppression / elevation	:	At least 100% of Span
12.	Output Indicator	:	Backlit LCD type
13.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
14.	Body	:	Forged Carbon Steel (SS for DM Water)
15.	Ambient temperature	:	0 - 50^{O} C
16.	Power supply	:	16 - 48 Volts DC
17.	Load	:	500 Ohms (min.) at 24 Volts DC
18.	Performance :-		
i)	Accuracy	:	±0.2 % of span or better
ii)	Repeatability	:	± 0.05 % of span or better
iii)	Response time	:	100 msec or better
iv)	Stability	:	± 0.1% of Calibrated Span for 6 months up to 70 Kg/cm2
v)	Zero and span drift	:	± 0.015% per deg. C at max span and 0.11% per deg. C at min span
19.	Sealing/Isolation	:	Extended diaphragm with 5 meters. SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator diaphragm, depending on application.
20.	Diagnostics	:	Self indicating feature
21.	Accessories	:	a) Universal mounting bracket suitable for2" pipe mounting.

b) High tensile carbon steel U-bolts.

c) Installation accessories as per relevant installation drawing.

d) Syphons for steam and hot water services.

e) ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock.

f) Companion flange with nuts, bolts and gaskets.

g) Hand held configurator kit for calibration of Smart Transmitter.

1.02.00 DISPLACER TYPE LEVEL TRANSMITTERS

01.	Type		:	SMART
02.	Stages of operation		:	Continuous
03.	Material -			
	i)	Displacer	:	AISI 316 SS
	ii)	Suspension wire	:	AISI 316 SS
	iii)	Torque tube housing	:	Carbon steel or SS as per application
	iv)	Torque tube	:	Inconel
	v)	Displacer chamber	:	Carbon steel or SS as per process application
	vi)	Transmitter Housing	:	Die cast aluminium or better
04.	Power supply		:	16-48 Volts D.C.
05.	Transmission		:	2-wire
06.	Output Signal		:	Simultaneous transmission of digital and 4-20 mA DC signal. Standard HART protocol.
07.	Signal processing		:	Solid-state electronic circuitry
08.	Static / overload pressure		:	Maximum static pressure without permanent deformation or loss of accuracy.
09.	Turn-down ratio		:	10 : 1 or better

10.	Zero & Span	:	Easily accessible (local zero & span adjustment and non-interactive type)
11.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12.	Output Indicator	:	Yes, Backlit LCD type
13.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
14.	Ambient Temperature	:	0 - 50^{O}C
15.	Load Impedance	:	500 Ohms at 24 Volts (minimum)
16.	Process Connection	:	2" Companion flange with nuts, bolts and gaskets
17.	Performance -		
	Accuracy	:	$\pm$ 0.2% of span or better
18.	Accessories	:	a) Counter Flange, nuts, bolts, gaskets etc. b) Weights for 5 point calibration of instruments. c) Vent and drain plugs d) Special calibration tool/configurator,if any.
19.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics. b) Electronic Damping facility (adjustable).

1.03.00 MASS FLOW METER

A. Sensor

01.	Measuring Principle	:	Coriolis Mass flow.
02.	Primary Element	:	Flow Tube of 316SS or better
03.	Temperature Control For Heating	:	To be provided for heavy fuel oil application. Heating arrangement shall be integral.
04.	Process Connection	:	Flanged and rating as per process requirement.
05.	Drain	:	Self-draining facility

	06.	Enclosure	:	Stainless steel
	07.	Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets etc.
	B.	Transmitter		
	01.	Measured quantities	:	Mass Flow rate, Total Mass Flow, Density, Temperature as minimum.
	02.	Input Signal Processing	:	Digital Processing.
	03.	Display	:	Digital Display (LCD).
	04.	Output	:	2 Nos. isolated output of 4-20mA DC with HART protocol, selectable from four measured quantities & field bus output for softlink with DCS
	05.	Load	:	< 750 ohms.
	06.	Power supply	:	"UPS", (if the external power supply is 230V AC, 50 HZ).
	07.	Turn Down	:	100:1
	08.	Accuracy	:	± 0.2% of measured value
	09.	Housing	:	IP 65 (Explosion proof for NEC Class-1, Division 1 area).
	10.	Hazardous duty Version	:	FM Standards.
	11.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
	12.	Accessories	:	a) As required for field mounting b) Handheld configurator c) Mounting U-bolts, nuts, bolts, prfab cable etc.
1.04.00	Turbine Flow meter			
	A.	Sensor		
	01.	Type	:	Turbine (in line full-bore, based on magnetic pick up pulses)

02.	Output Signal	:	Pulse		
03.	Material of Construction	:	a)	Body : AISI 316	
			b)	Rotor: AISI 431 or 410	
			c)	Bearings: Tungsten Carbide / Stellited Sleeve	
04.	Flow rate range	:	As required.		
05.	Linearity	:	± 0.25% or better.		
06.	Repeatability	:	± 0.02% or better.		
07.	Ambient temperature	:	$50^{O}C$		
08.	Mounting	:	On-Line, flanged		
09.	Enclosure	:	IP 65		
B.	Transmitter				
01.	Electronics	:	Solid State		
02.	Power Supply	:	"UPS", if the external power supply is 230V AC, 50 HZ.		
03.	Input	:	Input from Sensor		
04.	Display	:	Backlit LCD		
05.	Output	:	Isolated 4-20mA DC with HART protocol.		
06.	Measuring Accuracy	:	± 0.5% of full scale range		
07.	Totalized Value	:	Required		
08.	Housing	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)		
09.	Nameplate	:	Tag number, service engraved in stainless steel tag plate		
10.	Accessories	:	a)	Clamping strip, bracket, prefab cable etc.	
			b)	Calibration or cofigurator kit.	

1.05.00 Vortex Flow meter

A.	Sensor		
01.	Type	:	Vortex

02.	Output Signal	:	Pulse
03.	Material of Construction	:	AISI 316
04.	Sensor Seal	:	PTFE / higher based on temperature
05.	Flow range	:	As required.
06.	Linearity	:	± 1% or better.
07.	Repeatability	:	±0.2% or better.
08.	Ambient temperature	:	$50^{O}C$
09.	Mounting	:	On-Line, flanged.
10.	Enclosure	:	IP 65
11.	Accessories	:	Nuts, bolts, gaskets etc.
B.	Transmitter		
01.	Electronics	:	Solid State-remote mounting
02.	Power Supply	:	24 V DC.
03.	Input	:	Input from Sensor
04.	Display	:	Backlit LCD
05.	Output	:	Isolated 4-20mA DC.
06.	Protocol	:	HART
07.	Totalized Value	:	Required
08.	Housing	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
09.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
10.	Accessories	:	a) Clamping strip, bracket, prefab cable etc. b) Special tool kit for calibration/ configuration .

1.06.00 Rotameter

01.	Type	:	Online upto 2" and Bypass above 2" line size"
02.	Metering tube	:	Borosilicate glass
03.	Float	:	AISI 316-SS unless the process fluid demands some other material.
04.	Body MOC	:	SS as per fluid condition.
05.	Scale	:	Aluminium Graduated - Engraved black on white background.
06.	Process connection	:	Flanged to line size or threaded for connection size ½" or less.
07.	Accuracy	:	± 2% of full scale detection or better for on-line type and ±4% of full-scale detection or better for by-pass type.
08.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
09.	Accessories	:	Slip-on orifice plate of 316-SS and taps of / SS as per application. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.
10.	Housing protection class	:	IP- 65.

1.07.00 Pressure Gauge and Differential Pressure Gauge

01.	Type	:	Bourdon/Bellows/Diaphragm
02.	MOC Sensing & Socket	:	AISI-316 SS
03.	Movement Material	:	AISI-304 SS
04.	Case Material	:	Stainless steel..
05.	Bezel Material	:	SS 304.
06.	Socket Material	:	SS 316
07.	Enclosure	:	IP-65.
08.	Dial Size	:	150 mm

09.	Scale	:	Black lettering on white background in 270 Deg. arc.
10.	Window	:	Shatterproof glass
11.	Range Selection	:	Normal process pressure – 50 ~ 70 % of range (approximately).
12.	Over-range Protection	:	125% of maximum range by internal stop. External stop at zero
13.	Adjustment	:	Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment. External zero adjustment for glycerine filled gauges.
14.	Element Connection	:	Argon welding
15.	Process Connection	:	1/2" NPT(M) Bottom connection for local mounting, back connection for panel mounting.
16.	Performance	:	Accuracy of $\pm$ 1.0 % of span or better.
17.	Operating ambient temperature	:	0 - 50^{O}C
18.	Safety Feature	:	Blow out disc./diaphragm at the back
19.	Accessories	:	a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge. b) Stainless steel Diaphragm chemical seals for corrosive, viscous and solid-bearing or slurry type process fluids. diaphragm chemical seal shall be provided with the following: 1) Top chamber : SS 304 2) Bottom Chamber: SS 316 3) Sealing fluid: Silicon DC 200 4) Diaphragm: SS 316 c) 3-way SS gauge cock/ 2-Valve SS-316 barstock manifold for pressure gauges with 1/2" NPT process connection..

d) 5-valve SS316 manifold constructed from barstock for differential pressure gauge. Process connection ½" NPT.

e) Union, nut & tail piece and other Installation accessories as required.

f) Syphons for steam and hot water services.

	20.	Applicable standard	:	IS-3624 / 1996 , EN-837-1
	21.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

1.08.00 Temperature Gauge

	01.	Type	:	Inert gas filled remote mounting system.
	02.	Sensing Element Material	:	Bourdon - AISI-316 SS
	03.	Capillary Armoring	:	Stainless steel flexible
	04.	Movement Material	:	AISI 304 SS
	05.	Bulb / Stem Diameter	:	12 mm
	06.	Bulb / Stem Material	:	AISI 316
	07.	Capillary	:	Stainless Steel
	08.	Thermometer connection to well	:	½" NPT
	09.	Case Material	:	Stainless steel
	10.	Dial Size	:	150 mm in general (100 mm for SWAS gauges)
	11.	Scale	:	Black lettering on white background in 270 Deg. arc.
	12.	Mounting	:	Surface/Panel
	13.	Over range Protection	:	125 % of range or more
	14.	Instrument connection	:	Bottom connection for local mounting and back connection for panel mounting.

	15.	Range	:	Normal temperature – 50 ~ 70% of range approximately.
	16.	Zero adjuster	:	Micrometer screw adjustable from front.
	17.	Window	:	Shatterproof glass.
	18.	Accuracy	:	± 1 % or better
	19.	Enclosure Class	:	IP-65
	20.	Capillary	:	5 meters (local)/15.0 meters (local panel) - armoured stainless steel
	21.	Compensation	:	Capillary and Case Compensation
	22.	Accessories	:	a) Forged/barstock SS316 thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of thermowell: 1) SS 316: in general 2) Inconel: For flue gas application 3) Tungsten carbide: For coal mill application b) Installation accessories as required.
	23.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
1.09.00	Thermocouples			
	01.	Type	:	a) Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.) / Type-E (Chromel Constantan) [As per application] b) Duplex (Triplex incase of turbine/Generator/excitor bearing temperature may be used) c) Ungrounded
	02.	Wire gauge	:	16 AWG for Type-K, 24 AWG for Type-R
	03.	Standard	:	ANSI-MC 96.1.
	04.	Protecting Tube :-		
	i)	O.D.	:	8 mm
	ii)	Material	:	316-SS Seamless
	iii)	Filling	:	Magnesium Oxide (Purity above 99.4%)

05. Response time with Thermowell : a) Less than 20 seconds for measurement.

b) Less than 10 seconds for control.

06. Accuracy : $\pm$ 1.1^{0}C upto 300^{0}C & 0.4% of measured temperature range above 300^{0}C.

07. Head :

i) Type : IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)

ii) Material : Die cast aluminum or better

iii) Terminal blocks : Nickel plated Brass - screw type / silver plated

iv) Instrument connection : ½" NPT to well

iv) Cable connection : ½" NPT gland and grommet.

v) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shal be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells"

08. Accessories : a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection

b) Compression fittings/unions

c) Flanges etc. (for flanged connections only)

d) Barstock thermowell of stepless tapered design as per ASME PTC19.3 code.

Process connection M33x2 (M) in general or 11/2"flanged for flue gas/Furnace/air etc. application.

Material of construction of thermowell:

1) SS 316: in general

2) Inconel: For flue gas application

3) Tungsten carbide: For coal mill application.

	09.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

1.10.00 Passing condition of various drain valves shall be monitored by measuring drain pipe metal temperature at the downstream of the drain valves. Also Drum, SH, RH metal temperature measurement shall be provided. Necessary thermocouples shall be provided as per the following specification.

	01.	Measuring medium	:	Metal temperature
	02.	Metal of thermocouple element	:	Chromel-Alumel Type-K
	03.	Type of thermocouple ungrounded type.	:	Duplex with separate hot junctions,
	04.	Insulation	:	Mineral insulation Magnesium Oxide
	05.	Thermocouple wirer gauge	:	16 AWG
	06.	Protective Sheath	:	SS 321
	07.	Protective Sheath Dia	:	8 mm O.D.
	08.	Characteristics of thermocouple	:	Special limits of error as in ANSI MC 96.01.1975
	09.	Mounting Accessories	:	1/2" BSP SS sliding end connector, weld pad, weld on clamps of heat resistant steel SS 310.
	10.	Cold end sealing	:	SS pot seal with colour coded PTFE headed sleeve insulated flexible tails. Sealing compound - Epoxy resin
	11.	Minimum Bending Radius	:	30 mm
	12.	Length of T/C	:	30 mtrs. (minimum)

1.11.00 Resistance Temperature Detector

	01.	Type	:	Platinum (Duplex), Ungrounded
	02.	Resistance	:	100 ohm at $0^{O}C$
	03.	Base	:	Wound on ceramic (anti-inductive)
	04.	Wiring	:	3 /4 Wire

05.	Protecting Tube :-			
	i)	O.D.	:	8 mm
	ii)	Material	:	SS-316, Seamless
	iii)	Filling	:	Magnesium oxide (Purity above 99.4%).
06.	Response time		:	a) $<$ 20 seconds for measurement. b) $<$ 10 seconds for control.
07.	Calibration		:	DIN 43760
08.	Accuracy		:	$\pm$ 0.5% of range
09.	Head		:	
	i)Type		:	IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)
	ii) Material		:	Die cast aluminum or better
	iii)Terminal blocks		:	Nickel plated Brass-screw type / silver plated
	iv) Cable connection		:	½" NPT gland and grommet.
	v) Others		:	Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shal be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells"
10.	Accessories		:	a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection b) Compression fittings/unions c) Flanges etc. (for flanged connections only) d) Barstock thermowell of stepless tapered design as per ASME PTC19.3 code. Process connection M33x2 (M) in general or 11/2"flanged for flue gas/Furnace/air etc. application. Material of construction of thermowell: 1) SS 316: in general 2) Inconel: For flue gas application

3) Tungsten carbide: For coal mill application.

	11.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

1.12.00 Pressure Switch

	01.	Type	:	i) Piston for high pressure application (above 40 bar) ii) Bellow /Diaphragm for low pressure application (below 40 bar)
	02.	Sensing element material	:	AISI SS-316. All other wetted part SS316.
	03.	Case Material	:	Die-cast aluminum alloy with neoprene gasket.
	04.	Setter Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.
	05.	Over range	:	150 % of maximum pressure
	06.	Adjustments	:	a) Internal Set Point b) Differential adjustment
	07.	End Connection	:	1/2" NPT (M) bottom connected
	08.	Switch configuration	:	Two SPDT
	09.	Switch Rating	:	240V, 5A AC/220V, 0.5A DC
	10.	Switch Type	:	Snap acting, shock & vibration proof
	11.	Terminal Block	:	Suitable for full ring lugs for cable connection.
	12.	Elect connection	:	Plug in socket
	13.	Enclosure Class	:	IP-65 weather and dust proof (Explosion proof for NEC Class-1, Division 1 area).
	14.	Performance	:	a) Repeatbility $\pm$ 0.5% of full range b) Accuracy of Setting Indication of $\pm$ 1.5%
	15.	Ambient temperature	:	0 – 50^{O}C

16.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
17.	Accessories	:	a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application. MOC of seal material shall be as per process fluid requirement.
			b) Snubbers for pulsating fluid application.
			c) Syphons for steam and hot water services.
			d) Retention ring and screws for surface mounting.
			e) 1/2" NPT 2 Valve SS-316 manifold constructed from barstock
			f) Brass cable gland

1.13.00 Differential Pressure Switch

01.	Type	:	Bellows / Diaphragm / Piston actuated
02.	Sensing element material	:	AISI SS-316. For all other wetted part SS 316
03.	Case Material	:	Die-cast aluminum alloy with neoprene gasket.
04.	Setter Scale	:	Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment
05.	Over range	:	Static pressure on any one side, the other side being open to atmosphere.
06.	Adjustments	:	a) Internal set point adjustment b) Differential adjustment
07.	Process Connection	:	1/2" NPT (M) bottom connected / back connected.
08.	Switch configuration	:	Two SPDT
09.	Switch rating	:	240V, 5A AC/220V, 0.5A DC.
10.	Switch type	:	Snap acting type contacts, shock and vibration proof.

11.	Terminal Blocks	:	Suitable for full ring lugs for cable connection.
12.	Elect connection	:	Plug in socket
13.	Performance	:	a) Repeatbility $\pm$ 0.5% of full range b) Accuracy of set point Indication: $\pm$ 1.5%
14.	Operating Ambient Temperature	:	0 - 50^{O}C
15.	Enclosure	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area).
16.	Accessories	:	a) Snubbers for pulsating fluid application. b) Syphons for steam and hot water services. c) Retention ring and screws for surface mounting. d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock
17.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
18.	Remote Seal type for special application	:	a) Silicone oil / fluorolube filled remote diaphragm seal for dirty / viscous / corrosive fluid. b) SS armoured capillary at least 3 meters each. c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.

1.14.00 Temperature Switch

01.	Type	:	Inert gas filled-in
02.	Sensing Element Material	:	Bellow / Bourdon AISI SS-316
03.	Bulb Material	:	AISI SS-316
04.	Capillary	:	Stainless steel armoured
05.	Movement Material	:	AISI SS-304
06.	Case material	:	Epoxy coated steel plate or die-cast aluminum alloy with neoprene gasket and

clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).

07.	Scale	:	Black lettering on white background
08.	Over range Protection	:	120 %
09.	Instrument connection	:	Bottom
10.	Switch configuration	:	Two SPDT
11.	Switch rating	:	240V, 5A AC/220V, 0.5A DC
12.	Switch type	:	Snap acting, shock and vibration-proof.
13.	Adjustability	:	Internal Set point adjustable over span range
14.	Elect connection	:	Plug in socket
15.	Compensation	:	a) Capillary compensation with invar wire throughout the capillary length. b) Case compensation
16.	Performance	:	
	i) Scale Accuracy	:	$\pm$ 1.0 % of full scale
	ii) Repeatability	:	< 0.5 % of full range
	iii) Response time	:	Less than 40 seconds with thermowell
17.	Capillary length	:	5 meters (minimum) for local mounting/15 meters for local panel mounting.
18.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
19.	Accessories	:	Thermowell from SS barstock, Mounting accessories, ½" NPT cable gland.

1.15.00 Level Switch

01.	Type	:	External cage float operated. Magnetically coupled.
02.	Float Material	:	AISI-316 stainless steel or better
03.	Other wetted parts	:	AISI-316 stainless steel or better
04.	External Cage	:	Carbon steel / Stainless steel or better as per process requirements, welded type / flanged

construction. Cage pressure rating shall equal or exceed the rating of the main vessel.

05.	External cage mounting	:	Side-Side.
06.	External cage connection	:	25 NB socket welded.
07.	Switch housing	:	Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
08.	Type of switch configuration	:	2 SPDT (two nos.)
09.	Contact rating	:	5A, 240V/AC, 0.25A, 220V DC
10.	Accessories	:	a) Counter flange, nuts & bolts, suitable gasket etc. b) Steel globe type drain valve. c) ½"NPT cable gland d) Stainless steel alpha-numeric engraved for service and tag. e) Globe drain valve
11.	Preferred feature	:	Switch operating point marked on cage
12.	Mounting	:	On standpipe

1.16.00 Conductivity Type Level Switch

01.	Type	:	Conductivity discrimination.
02.	Application	:	Drain pots viz. on CRH line
03.	Mounting	:	Flanged – on external cage.
04.	Probe MOC	:	Stainless steel with high purity ceramic.
05.	Probe rating	:	> Maximum design pressure of vessel.
06.	Input	:	Four independent channel with selectable switching threshold for water conductivity.
07.	Relay Output	:	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.

08.	Contact type & rating	:	2SPDT or 1 DPDT @ 5A 30V DC.
09.	Local Display	:	Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
10.	Power supply	:	Dual 240V AC, 50 Hz, 1Ph UPS supply.
11.	Enclosure	:	IP–65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).
12.	Accessories	:	a) PTFE cable from probe to electronics b) Mounting accessories c) External cage d) Washer & gasket
13	Test pressure	:	Two times rated pressure
14.	Elect connection	:	Plug in socket

1.17.00 Capacitance Type Level Switch

01	Type	:	Capacitance type
02	Probe	:	a) Rod or suspended electrode b) Rope type probes may be used only where required probe length is greater than 1.5 meters. c) Reference rod for non grounded tank.
03.	Probe Mounting :	:	1-1/2” Flanged
04.	Material of construction	:	316 SS and to suit fluid type
05.	Insulation	:	PTFE/PP/Kynar Part/Full as required
06.	Enclosure	:	Powder coated Die cast aluminium. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
07.	Ambient temperature	:	0-60ºC.
08.	Mounting	:	Top Mounting
09.	Supply voltage	:	240V AC, 50 Hz, 1Ph UPS supply/ 24V DC

	10.	Relay output	:	2 SPDT
	11.	Contact rating	:	5A min. at 240V AC on resistive load
	12.	Response time	:	100 msec or better
	13.	Elect connection	:	Plug in socket
	14.	Accessories	:	Counter flange, cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.

1.18.00 RF Type Level Switch

	Sensing Probe		:	
	01.	Type	:	Rigid
	02.	Material	:	SS-316
	03.	Mounting	:	Threaded
	04.	Probe Head Housing	:	Cast Aluminium
	05.	Protection	:	IP-66
		Electronic Controller	:	
	01.	Supply Voltage	:	240V AC (UPS)
	02.	Relay Output	:	2 nos. SPDT
	03.	Contact Rating	:	240V AC,5A/ 220V DC, 0.25A
	04.	Housing Material	:	Cast Aluminium
	05.	Protection	:	IP-65
	06.	Local LED Indication	:	Power On, Alarm Level, Probe Healthy
	07.	Switching Repeatability	:	±0.5%
	08.	Accessories	:	Coaxial cable probe connection to controller ½”NPT Cable Gland

1.19.00 Ultrasonic Level Switch

	01.	Principle of operation	:	Ultrasonic contact level technology
	02.	Input Power	:	24V DC/ 240V AC

	03.	Output Contact	:	2 SPDT (240V AC, 5A/ 220V DC, 0.25A)
	04.	Switch Mounting	:	Integral
	05.	Sensor Material	:	SS-316
	06.	Enclosure	:	Cast Aluminium (IP-65)
	07.	Process Connection	:	2” Flanged
	08.	Repeatability	:	2 mm
	09.	Power supply	:	240V AC, 50 Hz, 1Ph UPS supply/ 24V DC
	10.	Cable connection	:	½” NPT with cable gland
	11.	Accessories	:	Cable gland, cable, companion flange, bolts & nuts, gaskets etc. along with all mounting hardware

1.20.00 Ultrasonic Level Transmitter

	01.	Principle of operation	:	Detection of reflected ultrasonic pulse
	02.	Signal processing	:	Microprocessor Controlled Signal Processing
	03.	Type	:	Smart
	04.	Display	:	Large alpha-numeric back lit LCD/LED
	05.	Calibration & configuration	:	Accessible from front of panel
	06.	Diagnostic	:	On-line
	07.	Status	:	For power, Hi / Lo / V. Hi / V. Lo-level indication, fault etc.
	08.	Construction	:	Plug-on board
	09.	Power supply	:	240V AC, 50 Hz, 1Ph UPS supply/ 24V DC
	10.	Signal Output	:	4-20 mA DC (isolated) - 500 Ohm load with HART protocol.
	11.	Hysteresis	:	Fully adjustable preferred
	12.	Output contacts	:	2SPDT Potential free changeover contacts @ 5A 230V AC.

13.	Accuracy & Repeatability	:	0.25% of span or better
14.	Resolution	:	0.1% of span
15.	Operating temp.	:	Transmitter- 0 to 50^{o} C and Sensor 0 to 80^{o} C
16.	MOC Sensor	:	SS 316 in general / PTFE, PP for corrosive application.
17.	Humidity	:	1% to 95% non condensing.
18.	Enclosure	:	IP-65 powder coated die cast aluminium
19.	Cable connection	:	½" NPT with cable gland
20.	Mounting	:	2" flanged for sensor and Transmitter on panel / surface.
21.	Accessories	:	Cable gland, prefab cable, mounting accessories.

1.21.00 Conductivity Type E lectronic Level Indicator

01.	Type	:	Conductivity discrimination.
02.	Application	:	Separator drum Level .
03.	No. of Probes	:	As per manufacturer standard.
04.	Probe Mounting	:	Flanged – on standpipe.
05.	Probe MOC	:	Stainless steel with high purity ceramic.
06.	Probe rating	:	> Maximum design pressure of vessel.
07.	Input	:	Independent channel with selectable switching threshold for water conductivity.
08.	Relay Output	:	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
09.	Contact type & rating	:	2 SPDT or 1 DPDT @ 5A 30V DC.
10.	Current output	:	Isolated 4-20 mA DC
11.	Local Display	:	a) Coloured (Red & Green) LEDs for level. b) Flashing LEDs for fault.
12.	Remote Display	:	Red, Green & flashing yellow LEDs for steam, Water & Fault indication respectively.

	13.	Power supply	:	Dual 240V AC, 50 Hz, 1Ph UPS supply.
	14.	Enclosure	:	a) IP–65, corrosion resistant & wall mounting type for local electronics. b) IP-42 for remote indicator
	15.	Accessories	:	a) PTFE cable from probe to electronics b) Mounting accessories. c) Standpipe d) Washer & gaskets e) Double isolation valves on each connection, double drain valves & double vent valves with mechanical lock. f) ½" NPT cable gland
	16.	Test pressure	:	Two times design pressure

1.22.00 Air Filter Regulator

	01.	Filter Element	:	Sintered Bronze
	02.	Filter Size	:	5 microns
	03.	Input Air	:	10.0 Kg/Sq. cm (maximum)
	04.	Output	:	Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg / Sq. cm (continuous) as applicable.
	05.	Effect of Supply	:	Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm
	06.	Bowl Material	:	Metallic.
	07.	Accessories	:	2" dial size output pressure gauge
	08.	Feature	:	No perceptible drop of pressure on opening the drain port.

1.23.00 SOLENOID VALVE

	01.	Operating Principle	:	Electromagnetic (noiseless)
	02.	Coil voltage rating	:	24V DC (in general) other 220V DC /240V AC /110V AC as required

	03.	Ways	:	3 ways in general other depending on requirement
	04.	Port size	:	1/4" NPT all ports
	05.	Body	:	SS Bar Stock
	06.	Trim	:	AISI SS-316
	07.	Manual Operator	:	In built
	08.	Duty	:	Suitable for continuous energization
	09.	Sealing	:	Airtight and leak proofing with nitrile (NBR) and polyurethane (PUR) material
	10.	Ambient Temperature	:	0 - 50^{O} C
	11.	Fluid Temperature	:	0-150^{O} C (approx.)
	12.	Coil Enclosure	:	Stainless Steel
	13.	Insulation	:	Class-H
	14.	Coil Casing	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
	15.	Response time	:	4-7msec
	16.	Mounting	:	On pipe or on panel
	17.	Cable Connection	:	½" NPT cable gland
	18.	Accessories	:	Mounting brackets, nuts and bolts
	19.	Special feature	:	(i) LED indication for power (ii) Double coil type for open & close operation of valve / damper. (iii) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity

1.24.00 ORIFICE PLATE

	01.	Application	:	Low fluid velocity flow measurement
	02.	Design Standard	:	Concentric as per ASME PTC-19.5 (Part –II), ISA RP-3.2 or BS-1042, Part-I
	03.	Number of Tapings	:	As required plus one additional pair of taps
	04.	Diameter Ratio	:	Between 0.34 to 0.7

	05.	Thickness	:	3mm for main pipe of diameter upto 250mm, 6mm for main pipe of diameter above 250mm and 10mm for diameter above 500 mm
	06.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	07.	Meter run pipe	:	Same as pipe material
1/2" SS316 globe	08.	Accessories	:	Flanges, gaskets, nuts & bolts, root valves ~~(1" 316 SS globe)~~ jack screw, meter run pipe, Drain & vent hole as per application etc.

NOTE: One flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

1.25.00 FLOW NOZZLE

	01.	Application	:	High fluid velocity flow measurement
	02.	Design Standard	:	ASME PTC 19.5
	03.	Tapings	:	D and D/2 (Numbers as required plus one additional pair of taps)
	04.	Diameter Ratio	:	Between 0.4 and 0.7
	05.	Material	:	316 SS ~~(321 SS for high temperature)~~
	05.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	06.	Meter run pipe	:	Same as pipe material
	07.	Accessories	:	Meter run pipe, nipples and root valves (1" 316 SS globe).(Inspection port assembly for nozzles used in plant performance purpose)

NOTE: One flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

1.26.00 GAUGE GLASS

	01.	Type	:	Reflex
	02.	Glass	:	Toughened borosilicate. Resistant to mechanical and thermal shocks.
	03.	Body material	:	Carbon steel / stainless steel- As per process requirements (Flanged Connection)
	04.	Pressure rating	:	Twice the maximum working pressure

	05.	Temperature rating	:	300^{O} C
	06.	Bolts and nuts	:	Rust proof alloy steel
	07.	Accessories	:	Suitable ball check valves of SS-304/316 body, gaskets, companion flange etc.

1.27.00 LEVEL GAUGE (FLOAT & BOARD)

	01.	Type	:	Float and Board
	02.	Float & Tape MOC	:	AISI 316
	03.	Pulley and Pulley Housing material	:	SS 304
	04.	Guide wire	:	SS 316 Stainless steel
	05.	Accuracy	:	+/- 2 mm
	06.	Indication	:	Vertical dial
	07.	Rating	:	Twice the design pressure
	08.	Spring tension assembly	:	SS 304
	09.	Anchor plate	:	SS304
	10.	Calibrated scale board	:	Aluminium with black graduation

Note: The measuring rope/tape shall be passed through conduits

1.28.00 POWER CYLINDERS (PNEUMATIC)

	01.	Mounting Type	:	a) Fixed position mounting (End mounting).
			:	b) Trunnion mounting
	02.	Control Signal	:	4-20 mA DC to smart positioner with HART protocol for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.
	03.	Supply Air	:	0-7 Kg / Cm^2.
	04.	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.
	05.	Casing	:	IP-65.

06.	Accessories (as required)	:	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Smart Positioner with integral I-P convertor, feedback position Transmitter (4-20 mA DC output),Input & Output pressure gauges, local keypad & display. g) Solenoid Valve h) Junction box with cable gland
07.	Fail-safe operation	:	Stay put for regulating duty.
08.	Repeatability	:	Better than 0.5% of full travel.
09.	Hysterisis	:	Less than ±1% of full travel
10.	Operating Temp. limit	:	80^{O} C (min.)

1.29.00 SIGHT GLASS

01.	Type	:	Flap-type
02.	End connection	:	Screwed / Flanged
03.	Material	:	
a)	Body	:	SS-304
b)	Cover Plate	:	SS-304
c)	Indicator	:	SS-316
04.	Sight Glass	:	Toughened Borosilicate
05.	Gasket	:	Neoprene
06.	Bolts & Nuts	:	High tensile steel
07.	Hydraulic Test		
	Pressure	:	1.5 times maximum working pressure
08.	Accessories	:	As required

1.30.00 SMOKE DENSITY ANALYZER

01.	Type	:	Insitu dry visible light (through LED)
02.	Principle of		

05.	Alarm/ Annunciation	:	Four Relay contacts, dual alarm set points (240V AC, 5A)
06.	Indication	:	LCD Display
07.	Sampling System	:	Extractive
08.	Enclosure	:	IP-65
09.	Power Supply	:	240V AC (UPS)
10.	Location	:	On Chimney
10.	Accessories	:	a) Inbuilt calibration facility through calibrator. Inbuilt cell for Zero & Span calibration to be provided. Handling of Liquid Mercury to be avoided. b) Remote calibration facility to be provided. c) The Mercury analyser cabinet to be placed inside an enclosed AC environment.

1.36.00 DEW POINT METER

01.	Type	:	Direct mounting capacitance type with change in output proportional to moisture present
02.	Sensing Element	:	Ceramic/ Aluminium Oxide sensor
03.	Service	:	Dry Air
04.	Range	:	-90 Deg.C to 10 Deg.C Dew point temperature
05.	Sensor Accuracy	:	±2 Deg.C Dew point
06.	Repeatability	:	0.5 Deg.C Dew point
07.	Op.Ambient		
	Temperature	:	-40 Deg.C to 50 Deg.C
08.	Op. Pressure	:	0-10 Kg/cm2
09.	Display	:	Combined enclosure with 5 digit seven segments LED display
10.	Element Filter	:	80 micron sintered stainless steel
11.	Output	:	4~20 mA DC loop powered
12.	Power Supply	:	24V DC nominal

	13.	Enclosure Class	:	IP-65
	14.	Interchangeability	:	Fully Interchangeable Transmitters
	15	Accessories	:	Sampling System, cables, sensor holder, dessicant chambers, souble compression fittings, ¾" cable gland, mounting fixture etc.

1.37.00 DENSITY METER

	01.	Operating Principle	:	Vibration Density measurement
	02.	Wetted Part Material	:	SS-316L
	03.	Case Material	:	Cast Aluminium
	04.	Output	:	4~20 mA DC
	05.	Electrical connection	:	½" NPT
	06.	Enclosure Class	:	IP-65
	07.	Local Display	:	Digital 5 digit, density display with temp. compensation
	08.	Accuracy	:	±1.0 %
	09.	Power Supply	:	240V AC (UPS)
	10.	Location	:	At the discharge of Gipsum bleed pump in FGD system.

1.38.00 RADAR TYPE LEVEL MEASUREMENT

	01.	Type	:	Radar based on Time Domain Reflectometry
	02.	Antena	:	Co axial / single rod type guided wave or Horn type as required for the application
	03.	Communication	:	Two wire 4-20mA DC, HART protocol
	04.	Environmental temperature	:	0 – 50ºC
	05.	Enclosure	:	Explosion proof /IP 65 as per application
	06.	Cable Entry	:	½" NPT
	07.	Calibration	:	a) Self calibration with internal reference b) Zero & Span calibration
	08.	Programming	:	Handheld programmer & Local key pad
	09.	Process Connection	:	Flanged /screwed

10	Transmitter Beam Angle	:	10 degree or less
11	Blocking distance	:	less than 300 mm
12.	Electronic Housing	:	Epoxy painted Die-Cast aluminium alloy
13.	Antenna / Flange assembly	:	316 SS or Hestalloy (as required)
14.	Output Indicator	:	Digital Integral Display (Backlit LCD/LED)
15.	Accuracy	:	5 mm or 0.1% of probe length
16.	Accessories	:	a) Programming tool kit b) Gasket

1.39.00 CHLORINE LEAK DETECTOR

01.	Type	:	Electrochemical
02.	Resolution	:	0.1 ppm
03.	Display Type	:	Digital Indicating Meter
04.	Operating Temperature	:	0~45°C
05.	Alarm Contacts	:	Dual Alarm setpoints (240V AC, 5A)
06.	Enclosure Class	:	IP-65
07.	Mounting	:	Wall mounting
08.	Power Supply	:	240V AC
09.	Output	:	4~20 mA DC (600 Ω load)

1.40.00 RESIDUAL CHLORINE ANALYZER

01.	Type	:	Amperometric
02.	Electrode	:	Platinum/ Gold and copper electrode shall be provided with cell cleaning system
03.	Display Type	:	LCD in Analyzer Panel
04.	Range	:	0 to 20.0 mg/L (ppm)
05.	Accuracy	:	2% or better . The measurement accuracy shall not be affected by presence of treatment chemicals as chromates,

			phosphates, de-former highly polluted water, change in temperature etc.
06.	Sensitivity	:	0.01 mg/L
07.	Alarm Contacts	:	Dual Alarm setpoints (240V AC, 5A)
08.	Enclosure Class	:	IP-65
09.	Power Supply	:	240V AC
10.	Output	:	4~20 mA DC (600 Ω load)
11.	Calibration	:	Zero & Span adjustment. Final calibration adjustments of the analyzer to be done at site and duly verified bt titration. Temperature compensation range 0-50°C.
12.	Mounting	:	Field mounting conform to IP-65
13.	Accessories	:	Chemical reagents, sample drain, pumping system (if required) etc.

1.41.00 ELECTRIC TO PNEUMATIC (E/P) CONVERTERS

01.	Air Supply	:	1.5 kg/cm2
02.	Max. supply Pressure	:	7 kg/cm2
03.	Input Signal	:	4-20 mA DC (as required by the design of control system).
04.	Output Signal	:	0.2 to 1.0 kg/cm2
05.	Control Action	:	Air to Close, Air to Open and Fail freeze-field selecable
06.	Response Time	:	5 seconds for 0 to 90% output pressure
07.	Repeatibility	:	+/- 0.1% span typical
08.	Accuracy	:	+/- 0.25% span typical
09.	Linearity	:	0.5% of span or better
10.	Hysteresis	:	0.1% of span or better
11.	Ambient Temp. effect	:	Less than 0.02% of span per ºC between

-20 ºC to +60 ºC

12. Supply pressure effect: less than 1%

13. Span and zero adjustment : screw

14. Mounting : Close to Actuator (but not on the actuator)

15. Output Capacity : To suit the actuator

16. Protection Class : IP 65

17. Allowable Drift Rate : ± 2% of set point / hour maximum

On loss of control signal, the last set point pressure shall be maintained so that the associated control valve remains in stay put condition.

1.42.00 SMART POSITIONER

01. Type : Universal design (linear or rotary application)

02. Input Signal : 4-20mA DC , 2 wire loop with 24V DC.

03. Output Signal (position F/B) : i) 4-20mA
ii) Configurable end position switch

04. Supply Pressure : Single acting 1.2 to 7.0 bar
Double acting 1.2 to 10.5 bar

05. Air Delivery : Single acting 10.0 SCFM at 2.1 bar supply
Double acting7.2 SCFM at 2.1 bar supply

06. Housing : IP 65

07. Repeatibility : +/- 0.3% of span or better

08. Accuracy : +/- 0. 1% of span or better

09. Communication : Hart protocol

10. Power-up with position : < 150 ms or better control

11 Power interruption without reset : <100ms or better

12. Body Material : Aluminium

13. Response Time : Less than 10 sec

14. Features	:	i) Noncontact position feedback sensor ii) Integral Electro-Pneumatic convertor ii) Self calibration with tunable response time iii) Online diagnostics iv) Pressure guages to be provided on positioner (I/P & O/P pressure)	

1.43.00 MAGENETIC LEVEL INDICATOR

01.	TYPE	:	Magnetically coupled level indicator
02.	Display	:	Coloured flags
03.	Chamber material	:	Stainless steel
04.	Wetted part material	:	Stainless steel
05.	Process connection	:	Side Side Flanged
06.	Drain & Vent	:	Flanged
07.	Scale	:	Standard, Stainless steel
08.	Accessories	:	Counter flange, gaskets

1.44.00 FLOW SWITCH

01.	Type	:	Paddle /Piston/Disk
02.	Wetted part material	:	Stainless steel or Hastelloy for acidic application
03.	End connection Tee	:	i) Threaded upto 1” line size with integral ii) Flanged for line size > 1 ½”
04.	Enclosure material	:	Die cast aluminium
05.	Enclosure class	:	IP 65
06.	Switch configuration	:	2 SPDT
07.	Contact rating	:	240V AC 15A
08.	Repeatibility	:	2%
09.	Cable connection	:	½”NPTF

10.	Accessories	:	Tee, counter flange

1.45.00 ULTRA SONIC TYPE FLOW METER

a) Ultrasonic Flow meter shall be dual path transit time clamp-on type.

b) The flow meters shall be of proven reliability, accuracy and repeatability requiring a minimum of maintenance. They shall comply with relevant international standards and shall be subject to approval.

c) CW flow shall be measured by redundant Ultrasonic Flow meter.

d) All accessories required for mounting/erection of these instruments shall be furnished, erected and installed as necessary for completeness of the system though not specifically asked for. Also the equipment shall include necessary cables, flexible conduits, junction boxes required for the purpose.

e) Flow meters shall be provided with suitable environment protection devices / structures such that they shall be suitable for continuous operation in the operating environment of a coal fired utility station without any loss of function or departure from the specification requirements.

f) Technical Requirements

01.	Type	:	Transit time Clamp On Ultrasonic meter
02.	Mounting Style	:	Dual path with two sets of transducers on the same pipe
03.	Flow measurement	:	Instantaneous Flow rate as well as totalized flow & velocity
04.	Power supply	:	240V AC, 50Hz with built –in battery back up.
05.	Analog Outputs	:	Isolated 4-20mA linear outputs for each path with HART for volumetric flow and velocity
06.	Binary Output	:	Contact relay outputs, 2 NO + 2 NC for alarm
07.	Communication ports	:	RS 232 C digital Hand held terminal port
08.	Display/Indication	:	Flow meter with LCD screen backlight based local display and keypad. If required, transmitter shall be suitably located away from the sensor for better access and visibility.
09.	Recording / Totalizing /		

	Logging Facilities	:	Yes. Should be able to compute cumulative flow over intervals selectable by Owner i.e., daily, weekly, monthly etc. The data shall be stored in the memory of flow computer for access in future.
10.	Software features	:	Compensation for any cross path errors Programming, configuration, shall be possible from front panel.
11.	Diagnostics	:	False signal tolerance , power supply failure etc.
12.	Protection Class	:	IP-65 or better, Weather protection against direct sunlight, rain etc for Flow meter and suitable for Cooling water for Transducer.
13.	Accuracy	:	± 1%
14.	Electrical connection	:	Plug and socket
15.	Accessories	:	All mounting hardware required like clamping fixtures, mechanism to remove the transducers online, interconnecting cables etc. All weather canopy for protection from direct sunlight and direct rain. Material of all fittings shall be SS 316

g) Bidder shall submit certified flow calculation and differential pressure Vs. flow curves for each element for Owner's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Owner's approval.

2.00.00 NOT USED

3.00.00 CONTROL PANEL/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES.

(For electrical System's Meter and for synchronisation, bidder shall refer to Electrical volume of specification)

3.01.00 Digital Indicator (If requird)

01.	Type	:	Five and half digit LED seven-segment display with sign.
02.	Display Character	:	13.8 mm, RED (LED)
03.	Accuracy	:	0.1% of reading, ±2 digit

	04.	Input	:	4-20mA DC/1-5 V DC/ pulse (as applicable)
	05.	Mounting	:	Flush Panel
	06.	Power Supply	:	240V ±10%, 50 ±2.5 Hz

3.02.00 PUSH BUTTON

	01.	Type	:	Shrouded square format
	02.	Face Dimension	:	32 x 32 mm (maximum)
	03.	Contact Configuration	:	2 NO + 2 NC
	04.	Contact Addition	:	Add-on block up to 4 each with 2 pairs of contacts
	05.	Contact Material	:	Hard Silver Alloy
	06.	Contact Rating	:	500V / 10 A
	07.	Utilization Category	:	AC11 / DC11
	08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
	09.	Mechanical Life	:	1 million operation
	10.	Construction	:	Aluminum shrouding with plastic lens
	11.	Colors	:	Red, Green, Yellow, Black, etc.
	12.	Connection	:	Screw terminals
	13.	Enclosure Class	:	IP-52
	14.	Legend	:	Engraving

3.03.00 ILLUMINATED PUSH BUTTON

	01.	Type	:	Square format
	02.	Face Dimension	:	32 x 32 mm (maximum)
	03.	Contact Configuration	:	2 NO + 2 NC (minimum)
	04.	Contact Addition	:	Add-on-Block up to 4 each with 2 pairs of contacts
	05.	Contact Material	:	Hard Silver Alloy
	06.	Contact Rating	:	500 V/ 10A

	07.	Utilization Category	:	A C11 / DC11
	08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
	09.	Mechanical Life	:	1 Million Operation
	10.	Lamp	:	LED with built-in resistors as required
	11.	Lamp Rating :-		
	a)	Voltage	:	240 V AC
	b)	Watt	:	2 Watt (approx.)
	12.	Lamp and Lens Replacement	:	From front
	13.	Construction	:	Transparent Plastic Lens
	14.	Color	:	Red, Green, Amber, Yellow etc.
	15.	Connection	:	Screw terminals
	16.	Enclosure Class	:	IP-52
	17.	Legend	:	Engraving

3.04.00 SELECTOR SWITCH

01.	Type	:	2/3/4 position stay put type with rotary lever actuator.
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Contact Configuration	:	4 pair of contacts
04.	Contact Addition	:	Add-on-Block up to 4 each with 2 pairs of contact
05.	Contact Material	:	Hard silver Alloy
06.	Contact Rating	:	500 V/10 A
07.	Utilization Category	:	AC11 / DC11
08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
09.	Mechanical Life	:	1 million operation
10.	Construction	:	Aluminum shrouding
11.	Connection	:	Screw terminals

	12.	Enclosure Class	:	IP-52
3.05.00	INDICATING LAMP			
	01.	Type	:	LED with built-in resistor
	02.	Face Dimension	:	32 x 32 mm (maximum)
	03.	Voltage	:	240 V AC
	04.	Watt	:	2.5 Watt (approximate)
	05.	Lamp and Lens Replacement	:	From front
	06.	Construction	:	Transparent Plastic lens
	07.	Color	:	Red, Green, Amber, Yellow etc.
	08.	Connection	:	Screw terminals
	09.	Legend	:	Engraving
3.06.00	INDICATING METERS (A.C)			
	01.	Type	:	Rectifier type taut band
	02.	Face Dimension	:	96 x 96 mm
	03.	Scale	:	Radial arc of 240 Deg.
	04.	Accuracy	:	1.5% of full scale. ±0.5 Hz for frequency meter
	05.	Input	:	0-1/0-5A for current measurement, 0-240V for voltage measurement, 50 ± 2.5 Hz for Frequency measurement
	06.	Zero Adjustment	:	Screw on meter face
	07.	Enclosure	:	Shielded Case IP-52
	08.	Mounting	:	Flush Panel
	09.	End Scale Suppression	:	6 times the measuring range only for motor ammeters
3.06.01	INDICATING METERS (D.C)			
	01.	Type	:	Taut band moving coil
	02.	Face Dimension	:	96 x 96 mm

	03.	Scale	:	Radial arc of 240 Deg.
	04.	Accuracy	:	1.5% of full scale
	05.	Input	:	0-75 mA for current measurement. Direct reading for voltage measurement.
	06.	Zero Adjustment	:	Screw on meter face
	07.	Enclosure	:	Shielded case IP-52
	08.	Mounting	:	Flush Panel
	09.	End Scale		
		Suppression	:	2 times the measuring range only for motor ammeters.

3.07.00 AUXILIARY RELAY

01.	Type	:	Plug-in type with base/DIN rail Mounted
02.	Coil voltage	:	240 V AC/24V DC / 220V DC
03.	Contact Configuration	:	2 NO & 2 NC (Minimum), additional contacts as per requirement
04.	Contact rating	:	250V/5A (A.C/D.C.)
05.	Operating range	:	80 to 110% of rated voltage
06.	Insulation	:	2 KV for 1 minute between terminals & earth.
07.	Mechanical life	:	20 million operations
08.	Enclosure	:	Transparent cover
09.	Connection	:	Screw terminals.
10.	Mounting	:	Projection mounting inside panel /DIN rail Mounting

Note : Coil protection: diode/surge suppressor shall be provided

3.08.00 COUPLING RELAY

01.	Type	:	Miniature plug-in type/ DIN rail Mounting
02.	Coil voltage	:	24 V D.C. / 48 V DC or others as required.
03.	Contact	:	2 NO & 2 NC (Minimum)-Additional contact as per requirement

04.	Contact rating	:	250 V/10A (A.C)/220V/2A (D.C)
05.	Operating range	:	70 to 110% of rated voltage.
06.	Insulation	:	2 KV for 1 minutes between terminal & earth.
07.	Mechanical life	:	20 million operations
08.	Coil protection	:	Diode
09.	Indication	:	Coil on LED
10.	Enclosure	:	Transparent cover
11.	Connection	:	Screw terminals.
12.	Mounting	:	Projection mounting inside panel / DIN rail mounting

4.00.00 CONTROL VALVES, ACTUATORS & ACCESSORIES

4.01.00 GENERAL REQUIREMENTS

4.01.01 Bidder shall exercise extreme caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attemperator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to condenser and in vacuum such as HP/LP heater emergency level control, condenser make up water control valve and CEP minimum flow control valve etc. For such critical applications, Bidder shall offer valves which are proven for similar application for not less than 2 years of continuous service in power plant environment. All the above valves shall have leakage class equal or better than class-V or as specified hereunder with metal-to-metal seating. For Severe Service Control Valves viz. BFP Recirculation Valves, PRDS Valves,Feed Control Valve, SH/RH Attemperation valve, Soot blower steam pressure control valve etc. multistage-multipath discrete pressure drop stage design shall be provided. HP and LP Bypass valves shall be designed for 60% bypass capacity with twin valves. Typical Requirements for these Control Valves shall be as follows:

Service	:	BFP Recirculation Valve/RH-SH Attemperator Valves
Type	:	Multi Stage, Multi Path stack Plate radial Flow design
Trim	:	Angle Design (side inlet and bottom outlet, over the plug flow) or Globe design (for straight pipe)
Trim exit v*elocity*	:	Not exceeding 23m/sec
Pressure reducing /drop	:	Achieved in multi stage orificed, drilled hole or axial flow cage design
Seat Leakage	:	In accordance with MSS-SP-61
Actuator type	:	Pneumatic Piston type ensuring MSS-SP-61 seat leakage

4.01.02 Control valves for regulating service shall normally be globe body, cage guided, metal-to-metal seated, pneumatically operated and shall be provided with characterized plugs having ANSI leakage class-IV as minimum. All steam temperature conditioning control valves shall be ANSI leakage class-V.

4.01.03 Where the operating time is critical for the operation of the plant, as in case of HP or LP bypass valves, hydraulic actuators with electro-hydraulic interface shall be offered. Block valve in the spray water line for HP or LP bypass valves shall also be hydraulically operated.

4.01.04 Bidder shall provide redundant control valves for main condensate control station, Superheat attemperation control and Reheat attemperation control as a minimum. For other application, if the availability criteria for the plant can not be met even with the best established product, redundant control valves shall be provided.

4.01.05 All control valves shall be located near floor or platform for ease of access with adequate clearances for maintenance and lay-down and shall be placed as control station with up-stream and down-stream motorized isolating valves, manual drain valves and motorized inching bypass valve. For Superheat attemperation control and Reheat attemperation control, upstream and down stream isolation valves shall be solenoid operated pneumatic on-off valves. Block valve in the spray water line shall also be solenoid operated pneumatic on-off valve.

4.01.06 Control Valves and accessories shall be designed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, ASME Boiler and pressure vessel code, Indian Boiler Regulation (IBR), ISA and other standards as specified elsewhere and in accordance with the applicable requirements of the Federal Occupational Safety and Health Standards, USA or acceptable equal standards.

4.01.07 The start–up system control valves and HP & LP bypass control valves shall be proven in similar application.

4.01.08 All control valves shall meet the specification requirements and process requirements.

4.01.09 For large flow conditions with low pressure drops, as in case of cooling water applications, butterfly valves shall be used.

4.01.10 High Pressure Bypass Control Valve

1. Body shall be designed to withstand thermal cycling. Thin walled sections shall be provided in areas after pressure reduction to reduce thermal fatigue.

   Transitions between thick and thin wall sections shall be gradual. The body shall be a single shape steam entry from the bottom (under the plug) to facilitate easy and clean installation.

2. Valves shall be designed that they can operate in any orientation. For maintenance purposes the preferred orientation is vertical.

3. The HP bypass shall have desuperheating function in the valve body. Water injection must be at a fixed point inside the valve spraying into the turbulent steam flow. Water shall not be injected through the stem due to leakage potential past internals seals and to eliminate possibility of stem cracking due to combined thermal and mechanical stress. Water spray should be fully atomized within 1m of valve outlet to ensure uniform reheater temperature and flexibility in downstream piping layout.

4. Body shall be protected from damage due to water injection by means of multi function contoured cage. Contoured cages shall be used as they have higher mechanical strength and no tendency to resonate.

5. Cage material must be of a high alloy material such as X20Cr Mo V121 for good thermal cycling and erosion resistance.
6. Contour of cage to be of hour glass shaped form to improve the strength of the cage. The cage shall be firmly attached at one end and located radically at the other end to provide good guiding and allow axial growth due to thermal differentials.
7. Plug type shall be channel slotted design for acoustic attenuation and to allow passages of nominal contamination. Plugs of multiple holes design are unacceptable due to contamination catching between plug and seat. Contoured plug designs are not allowed because of poor acoustic performance.
8. Packing box design shall consist of two independent sets of rings separated by a metallic spacer. Packing to be compressed by means of a bolted flange design. Screwed gland type packing retainers shall not be provided.
9. Bolted bonnets are preferred. If pressure seal bonnet are used, seal areas shall be inlayed with corrosion resistant materials to minimize leakage potential.
10. The bypass valve should conform to MSS SP-61 or EN12266-1 Rate C leakage class (block/isolation valve tightness). Bidder to provide calculation.

4.01.11 Low Pressure Bypass Control Valve

1. Body shall be designed in angle shape for ease of installation and maintenance.
2. Valves shall be designed that they can operate in any orientation.

   Note that the typical orientation for LP-Bypass valves is horizontal with straight outlet to the condenser.
3. Skirted-plugs shall not be used due to potential for contamination and sticking between plug and seat. A combination of cage guiding and top guiding for plugs shall be provided to eliminate possibility of vibration.
4. No components may be screwed or welded inside the valve body for ease of maintenance.
5. Inlet cage and seat shall be easily removable for inspection maintenance and replacement. They shall be hold in place by the bonnet bolting and flexible gaskets shall accommodate differential thermal expansion.
6. Water injection to be downstream of pressure reduction to maximize evaporation.
7. Diffuser in the outlet to reduce noise and guide steam towards spray nozzles for good mixing of water and steam.
8. Water shall not be injected through the stem due to leakage potential past internals seals and to eliminate possibility of stem cracking due to combined thermal and mechanical stress.
9. Water injection shall be performed through spray nozzles. Spring loaded nozzles are preferred to maximize atomization at lower flow

rates. Multiple nozzles shall be used for uniform spray pattern. Water injection shall be perpendicular to stem flow for good penetration and mixing.

10. Packing to be compressed by means of a bolted flange design. Screwed gland type packing retainers shall not be provided.

11. Bolted Bonnets are preferred. If pressure seal bonnets are used, seal areas shall be inlayed with corrosion resistant materials to minimize leakage potential.

12. The bypass valve should conform to MSS SP -61 or EN12266 – 1 Rate C leakage class (block/isolation valve tightness). Vendor to provide calculation.

4.01.12 Spray water Valves

1. Valves shall be provided with rated cavitation index (Kcr) above Cavitation index for the process (Kc) where Kc=(P1-P2)/(P1-Pv)

2. Valves shall be free of cavitation. Should process condition produce cavitation, valve design shall be upgraded to eliminate cavitation.

3. The trim should be quick change type. No parts should be screwed or welded.

4. Isolation valves must be provided upstream of the HP-Bypass spraywater control valves, to ensure tightness of the spraywater line whenever the steam valve is closed. Individual isolation valves per control valve are recommended. Isolation valves are to be shut whenever the steam valve is closed.

5. Isolation valves upstream of the LP-Bypass spraywater control valves are recommended to allow shut-off of the water line. Isolation valves are to be shut whenever the steam valve is closed.

6. The valves should conform to MSS SP -61 or EN12266 –1 Rate C leakage class (block/isolation valve tightness). Valve trim exit velocity should be below 23 m/sec.

4.01.13 Hydraulic System

Hydraulic actuation is used for positioning of bypass control valves to fulfill the high stroking speed, high actuation forces and accurate positioning requirements. The hydraulic actuation system consists of one or more hydraulic supply units as required by the capacity and the distances between the valves and the hydraulic actuators and accessories.

4.01.14 Hydraulic supply unit

The hydraulic supply unit shall have the following features:

- fully redundant main pumps with 100% capacity. Switch over from main to standby pump should be fully automatic. Both pumps can be main or standby pump.
- Operating pump should run continuously to avoid unnecessary switching of main pumps and power peaks.

- Filter loop with continuous filtration of the oil. Filter change possible without switching off main pumps to avoid shutting down bypass for filter change.
- Oil filling must take place with the filter pump through the filter.
- Oil cooler with controlled fan to keep oil temperature within limits for the used hydraulic oil.
- Optional oil heater if ambient temperatures are getting below minimum limits of hydraulic fluid.
- The hydraulic supply unit should be able to generate constant outlet pressure of 160 bars and should have constant pressure and forces at the actuator.
- Accumulator pressure should be above the controlled outlet pressure to ensure sufficient reserve volume in the accumulators.
- Reserve volume in accumulator should be sufficient to allow min. 2 strokes of all actuators after trip of main pumps.
- Hydraulic supply unit should be equipped and completely wired and tested with local control and power switches. Manual control of the hydraulic supply unit through push buttons on the front panel for commissioning and testing.
- Drip tray shall be supplied together with the hydraulic supply unit.

4.01.15 Hydraulic actuators

- Hydraulic actuators shall be of compact heavy duty design and shall fulfill all force, stroke and stroke speed requirements of the valves.
- Actuators shall be of compact design with proportional valves and auxiliary elements directly flanged to the actuator, without connection pipes between these elements and the actuator
- Position control shall be performed with the help of proportional valves
- System must include accessories for quick stroking and safe opening and safe closing. Quick stroking accessories are not required if control through proportional valves meets quick stroking speeds (typically 2-3 seconds).
- Energy for safe opening or closing (e.g. condenser protection) shall be independent of the oil pressure from the HSU, either through steam force or a separate hydraulic accumulator.

4.01.16 Hydraulic positioner

- Hydraulic positioned shall be of digital smart type featuring simple adjustment through digital interface.
- For easy commissioning and maintenance positioners are located close to the valve/actuator and must be suitable for the harsh environment. Connections to the actuator shall be prefabricated and pluggable.
- The positioned is the only connection point for the plant cabling to the valve/actuator.

- Positioner should be absolutely stable at stroke speeds of 2 seconds
- Positioner shall have standard 4-20 mA signals for position demand and position feedback.
- Power supply options must be available for easy adaptation to the power supply available in the plant.

4.01.17 Bypass Controller

- Control system shall be state of the art, digital type.
- Control system should have redundant power supply to ensure reliability
- Control system shall be suitable to operate from 0 to 50 degree Celsius.
- Input/output modules, Power supply modules and CPU modules shall have hot swap feature and shall be replaceable while the plant is in operation without any disturbance of the other module.
- Input/output modules, Power supply modules and CPU modules shall have no slot dependencies for easier use.
- Interface with main DCS shall be MODBUS.

4.02.00 VALVE CONSTRUCTION

4.02.01 All valves shall generally be of globe body design and straight through pattern with single seat unless otherwise is specified or recommended by the manufacturer for particular application. However, Bidder may offer angle body valve for high pressure drop applications. For high pressure drop applications, construction of the valve shall be such that the gland is not exposed to full line pressure.

4.02.02 Valves with high lift cage guided plugs and quick replacement trims shall be provided for easy maintenance.

4.02.03 Plug shall be one piece construction either cast, forged or machined from solid stock. Plug shall be screwed and pinned to valve stem or shall be integral with valve stem.

4.02.04 Bonnet joint shall be of flanged and bolted type or manufacturer standard acceptable to Owner. Bonnet joints of internal threaded or union type is not acceptable.

4.02.05 Extension Bonnet shall be provided for fluid temperatue above 280 deg C.

4.02.06 Valve characteristics shall match with the process characteristics.

4.02.07 All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum application (i.e. double vee type chevron packing).

maximum

4.02.08 Flanged valves shall have ~~minimum~~ body rating ANSI 300 lbs.

4.02.09 The direction of flow shall be clearly marked/engraved on the body.

4.02.10 Valve body rating shall meet the process pressure and temperature requirement as per ANSI B 16.34.

4.02.11 Control valve body shall be selected as per the ISA guideline. Generally control valve body shall be cast and machined for pressure rating up to 1500 lbs. Above 1500 lbs, valve body shall be of forged steel. For Demineralized Water application valve body shall be Stainless Steel.

4.03.00 VALVE BODY

Valve body material shall generally be guided as per the Table below:

SR. NO.	SERVICE		BODY MATERIAL
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature upto 275ºC (like Aux steam flow to Deaerator, condensate flow to Deaerator, CRH flow to Deaerator)	:	Compatible with piping material but not inferior to Cast carbon steel ASTM A216 Gr. WCB
2.	Severe flashing / cavitating services (like HP & LP heaters emergency drain, Deaerator overflow drain to hotwell etc.)	:	Alloy steel as per ASTM A217 Gr. WC9
3.	Low flashing / cavitating services (like HP & LP heaters normal drain level control, GSC minimum flow, gland seal steam pressure control etc.)	:	Alloy steel as per ASTM A217 Gr. WC6
4.	DM water application (like condenser hotwell normal and emergency make up, ECW DP control etc.)	:	316 stainless steel ASTM A351 Gr. CF8M

4.04.00 VALVE TRIM

4.04.01 Valve trim for most applications up to leakage class-V shall be stainless steel 316 SS for pressure drop up to 7 Kg/ Sq. cm.. For pressure drops above 7 Kg/Sq. cm hard trim (stelliting or equivalent) shall be used. Other alloys shall be substituted if required for corrosion and other fluid conditions.

4.04.02 Balanced trim valves shall be offered for high shut-off pressure or high pressure drop condition to reduce the size of the actuators. For flashing services and two stage mixtures, the trim material shall be 17-4 PH or equivalent. If cavitating condition is foreseen, Bidder shall offer multistage or labyrinth trim valves. Trim of severe service valves as indicated in Cl. 4.01.01 shall be of multistage and multipath design with sufficient no. of discrete

pressure drop stages to eliminate the chances of erosion, cavitation, noise and vibration throughout the control range of the valve.

4.04.03 Quick replacement type trim shall be considered for easy maintenance.

4.04.04 Trim Material

Valve trim material shall generally be guided as per the Table below :

SR. NO.	SERVICE		MATERIAL
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature upto 275ºC.	:	316 SS with satellite faced guide posts and bushings
2.	Severe flashing / cavitating services	:	400 series SS or equivalent to suit the specific requirement
3.	Low flashing / cavitating services	:	400 series SS or equivalent to suit the specific requirement
4.	DM water application (condenser hotwell normal, emergency make up etc.)	:	316 SS

cavitation resistance, corrosion resistance, temperature resistance, erosion resistance, hardness etc. of the offered material vis-à-vis the specified material for Bidder may offer valves with body and trim material better than the specified material and in such cases Bidder shall furnish the comparison of properties including Owner's approval.

4.05.00 VALVE END PREPARATION

Valve body ends shall be either butt welded/socket welded, or flanged (Rubber lined for condensate service). Control valves of size 65 mm and above shall have butt welded ends as per ANSI B 16.25. For valve size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends shall be of ANSI pressure-temperature class equal to or greater than that of control valve body.

4.06.00 VALVE SIZE

The control valve sizing (Cv / Kv) shall be based on following guidelines :

a) The valves shall pass normal rate of flow (MCR condition) with 65 to 75 percent opening for linear characterised valves and 75 to 85 percent opening for equal percentage characterised valves.

b) The valves shall have adequate rangeability to pass the minimum and maximum rated flows at 10% and 80% of the valve opening

respectively. Valve stem travel range from minimum to maximum flow condition shall not be less than 50% of the total valve stem travel.

c) Valve Cv shall be selected in such a way that the valve shall be capable of handling at least 120% of required rated flow.

d) The valve selection shall be based on the highest size dictated by the above considerations unless noise, flashing or other factors dictate the final selection.

e) The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard.

f) While deciding the valve size, Bidder shall ensure that valves port outlet velocity does not exceed 8 m/sec for liquid services, 150 m/sec for steam services and 50% of sonic velocity for flashing services.

g) Control valve induced noise shall not greater than 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.

h) Bidder shall submit the sizing calculation clearly indicationg the valve outlet velocity, noise calculation during detail engineering stage for Ownner's approval.

4.07.00 VALVE TOPWORK

4.07.01 Topwork shall be sized so that the valve shall operate properly when upstream pressure is 10 percent above maximum inlet pressure and downstream pressure is atmospheric.

4.07.02 Bonnet material shall be same as that of valve body or equivalent forged material.

4.07.03 Extended bonnet/Finned bonnet and high temperature packing shall be used for high temperature application. Extension bonnet shall be used when the fluid temperature is high and may damage valve stem packing.

4.07.04 The gland material shall be chosen to suit the operating temperature. PTFE may be chosen for low temperature application and for high temperature application graphited asbestos glands are to be provided. For vacuum services, the glands shall be dry seal type.

4.08.00 NOISE LEVEL

The equivalent sound level measured at 1.5 M above nearest floor level in elevation and 1 M horizontally from the control valve expressed in decibels to a reference of 0.0002 microbar shall not exceed 85 dBA. If the calculated noise is more than the above limit, even with low noise trim design, diffusers shall be included. Diffusers shall be made of stainless steel and shall be integrally connected to the control valve with necessary spool piece. The spool piece shall be in conformity with the main line piping specification.

4.09.00 VALVE ACTUATORS

4.09.01 Spring-diaphragm type valve actuators shall be used in general applications. However piston type actuators shall be offered in case of high shut-off pressure & quick response requirement. Bidder shall provide piston type actuators for regulating services for the following services as a minimum requirement. Piston actuator shall be of double acting type for the regulating duty valves with long stem travel for better regulation and quick response.

a) Auxiliary Pressure reducing & De-super heating stations.

b) Superheat and Reheat Spray Control Valves.

c) Condensate extraction pump minimum recirculation valve.

d) Feed control valves

4.09.02 The actuator shall be designed for 150% thrust required for the valve (at shut-off pressure) at an air line supply pressure of 5.5 Kg/Sq. cm.

4.09.03 All the actuators shall be supplied mounted on the valve with all the accessories integrally mounted. The diaphragms shall be designed for 200% maximum operating pressure.

4.09.04 Nylon reinforced neoprene shall be used as diaphragm material.

4.09.05 Valve actuators shall be capable of operating at 60 deg C ambient, continuously.

4.09.06 Entire actuator assembly shall be painted with corrosion inhibiting paint.

4.09.07 Air connection size shall be 1/4" NPT (F) unless otherwise dictated by process response time. Integral tubing shall be of stainless steel construction.

4.09.08 Bidder shall indicate the stroking time of the valve assemblies with positioner, which shall not exceed 10 sec unless otherwise stated.

4.09.09 All actuators shall be of fail safe design signifying that the spring direction will tend to move the valve (open or close) in a direction safe for the process. “Failure to Open” or “Failure to Close” shall be marked on the actuator.

4.09.10 HP and LP bypass and spray valves, turbine inlet stop & control valves shall be electro-hydraulic actuators and all other control valves shall have pneumatic actuators.

4.10.00 VALVE POSITIONERS

4.10.01 All regulating service valves shall be offered with HART protocol based Smart Electro Pneumatic Positioners to ensure accuracy and repeatability of response.

4.10.02 Positioners shall have integral I-P converter, Position feedback transmitter, input and output gauges, local keypad & display .

4.10.03 Positioners shall be capable of functioning under hot, humid and vibrating conditions.

4.10.04 Positioner casings shall be dust tight, corrosion resistant and weatherproof (IP-55).

4.10.05 In general, positioner shall operate at signal range 4 – 20 mA DC for the full travel of the valve. Split range operation in few cases may be required. Remote calibration from control room shall be possible through HART management station.

4.11.00 VALVE ACCESSORIES

The accessories of the valves shall include side mounted hand wheels, smart positioner, limit switches, tubing and air set, junction boxes, airlock relays, volume booster, solenoid valves, and any other devices as required.

4.12.00 TESTS

All valves shall be tested in accordance with the Quality Assurace Programme (QAP). Bidder shall submit QAP for Owner's approval. The tests shall include but not be limited to the following :

01. Non destructive test as per ANSI B 16.34.

02. Hydrostatic shell test as per ANSI B 16.34 prior to seat leakage test.

03. Valve closure test and seat leakage test as per ANSI B 16.34 and as per the leakage class

04. Functional test : The fully assembled valves with actuator and all accessories shall be functionally tested to demonstrate from open to close position and vice versa. Valve lift shall be checked at 5 points at 0, 25, 50, 75 and 100% in both the directions with increasing and decreasing inputs. Performance of the valve with Positioner shall be as follows :

    a. Linearity : +/- 1%
    b. Hysteresis : +/- 1%
    c. Sensitivity : +/- 0.5%
    d. Deadband : +/- 1%
    e. Reproducibility : 0.3% of total stroke
    f. Overall accuracy : +/- 1%

05. CV test : Cv test shall be carried out as type test on each size, type and design of the valves as per ISA 75.02 standard and test report shall be submitted for Owner's approval.

5.00.00 CONTROL DESK / PANEL / RACK

5.00.01 Convenient and logical approach to operational interfaces shall be considered to enhance aesthetics in the overall view of the control room..

5.00.02 For items susceptible to vibration, suitable rubber gaskets or padding shall be provided to prevent damage or malfunction.

5.00.03 All items like MCB, Terminals, instruments, lamps etc. inside the panels/cabinets shall be neatly arranged with easy access/ maintenance approach to avoid undue disturbing the wiring.

5.00.04 Incoming power supply feeders shall be Redundant UPS Power supply feeders, so that a single failure shall not affect the operation of the unit. Required isolation & protection through MCB shall be provided in all cases. Alarm shall be provided against failure of a single power supply. Duplication/looping of Power supply feeders at the Panel terminal is not acceptable. Redundant UPS power supply feeders shall form Primary & Secondary power supply Bus and further power distribution shall be from these busbars.

5.00.05 Desk / panel shall be provided with interior illumination lampwith door switch, space heater with thermostat and 5A, 3 Pin receptacle with plug. Exhasut/cooling fans with fan failure alarm shall be provided.

5.00.06 Lamp, heater, exhaust fan and receptacle circuits shall be suitable for available AC supply and furnished with individual ON-OFF switch. The ON-OFF switch of the 3 pin receptacle circuit shall be Illuminating type.

5.00.07 Panel / Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.

5.00.08 Panels / enclosure shall be provided with 20% spare terminals. In addition, the spare hot on rail mounted input output channels /modules shall be in fully wired & terminated condition for system cabinets.

5.00.09 Wire shall be routed/laid in the covered PVC cable trough/tray.

5.00.10 Nameplate

a) Nameplate shall be furnished for each instrument or device mounted on the panel/desk.

b) The material shall be laminated phenolic, 3 mm thick with white letters on black background.

c) The nameplates for panels / consoles shall be provided both on the front and the rear.

d) Nameplates for all devices shall be located adjacent to the respective devices.

5.01.00 UNIT CONTROL DESKS

5.01.01 All devices mounted on the control desks shall be flush type. Instruments / devices shall be so mounted that the removal and replacement can be accomplished individually without interruption of services to others.

xiv) Front and Rear door shall be considered.

5.02.00 BACK UP PANEL / ELECTRICAL PANEL

5.02.01 Back Up Panel shall be of free standing type vertical panel with doors at the back. Construction shall be made from sheet steel of thickness not less than 3mm with mosaic grid structure of approximate size 24 X 48 on the front surface. Grid shall be heat resistant, flame retardant, self extinguishing, shrinkage free, non reflecting type. Finish shall be mat type without flaring. Indicators /ammeters, conductivity type EWLI for seperator, electromatic safety valve controls etc. shall be mounted on the panel..

5.02.02 Electrical Panel construction & design shall be similar to back up panel. Required control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. alongwith associated mimic diagram shall be provided for manual synchronization of generator.

5.02.03 Crating of the panels shall protect against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.

5.03.00 CABINETS / ENCLOSURE / PANELS

01.	Material of construction	:	Cold rolled steel sheet
02.	Thickness of Sheet	:	a) 3.0 mm for faces supporting instruments / terminals. Mounting plate shall also be 3.0 mm. b) 2.0 mm for other sides inclusive of top.
03.	Construction	:	Welded throughout as per (metallic parts) approved National Standards.
04.	Panel height	:	2300 mm maximum
05.	i)Corners	:	7 mm inner radius
	ii) Dimensional Tolerances	:	a) In height & length - 3 mm b) In height between adjacent sections - 2 mm. c) Total for a group - 6 mm
06.	Doors	:	Double, recessed, turned back edges. Doors shall have 4 point IP Lock
i)	Thickness of Sheet	:	2 mm

ii)	Hinges	:	Stainless steel
iii)	Door latches	:	Three point type
iv)	Door gaskets	:	Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
v)	Opening of the doors	:	Outward. Door swing shall be Min. 110-120 Degree
vi)	Louvers	:	With removable wire mesh to ensure dust and vermin proof.
07.	Color of interior	:	Brilliant white (Approval shall be accorded by owner during detail engineering)
08.	Colour external	:	RAL 7032 (Approval shall be accorded by Owner during engineering)
09.	Painting	:	Epoxy powder coated or better. Minimum Paint thickness shall be 80-100 microns
10.	Gland plates	:	Removable 4 mm thick (bottom)
11.	Cable entry	:	Bottom
12.	Hardware	:	a) Anti vibration pad- 15 mm b) Predrilled base channel ISMC - 100 or equivalent for all sides. c) Lifting hook / Eye bolt d) Drawing pocket e) Door switch, lamps, thermostat, heaters and fans
13.	Enclosure Protection	:	As per environment condition of the area of installation. Refer to Section-I of Vol-IIE clause 6.16.00.

5.04.00 LOCAL INSTRUMENT RACKS & ENCLOSURE (EXCEPT OFFSITE/BOP AREAS)

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, isolation valves, integral junction box with outside access door, illumination etc. Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging. Following requirements for LIE/LIR shall be met:

1) Not more than Six (6) Instruments shall be grouped in a single Rack/enclosure".

2) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application where as for applications such as for water and steam, racks to be installed below the source point.

3) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential and guage Pressure measurements such as flue gas, furnace and coal air mixture applications. Intermittent purging shall be adopted for Pressure measurements in air application or wherever required.

5.04.01 Closed Type Transmitter Racks

a) Required number of transmitter racks shall be furnished to house transmitters, switches and converters by grouping them suitably, area-wise / function-wise. Closed type Instrument rack to have the list of the Transmitters & Switches along with the service and KKS tag on the inner face of the front door. Moreover each Transmitter/switches mounted on the 2" pipe shall have label indicating the KKS tag.

b) The transmitter enclosures 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. Base frame shall be made of ISMC 100 and black colour finish

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 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) 2"NB Galvanised pipes shall be laid horizontally and supported at two end channels to mount transmitters/switches at accessible height. Adequate support for Manifold, impulse pipe and cable tray to be provided and the same shall be adjustable.

e) Doors shall have concealed quick removal type pinned hinges and locking handles. Doors locks shall accept the same key all over the plant. 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. Doors shall have three point Locking system. Doors shall have concealed quick removal type pinned Stainless steel hinges.

f) Bulkheads, especially designed to provide isolation from process line vibration shall be installed on modular bulkhead plates of the transmitter enclosures to meet the process sensing line connection requirements. Removable top and bottom plates shall be furnished. Removable bulk head plates of thickness not less than 6mm shall be mounted on the racks with suitable high temperature gasket impulse line within the enclosures shall be properly clamped..

g) 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.

h) 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, whereas, 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. Individual Instrument blowdown line shall be connected to the common blowdown drain header through regulating globe type blowdown valves. The common blowdown drain header shall be 2" NB ASTM A106, Sch-80 Gr. C installed at a slope of 1:25

i) Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations.

j) Service Power and Lighting

i) Each enclosure shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.

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

k) 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 an 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.

l) Service Air

In case of Continuous air purging, a 25NB (1") service header shall be formed which shall receive air through isolation valve and air filter regulator. Air shall be fed from air header to impulse pipes near to take-off points through isolation valves and flow regulators. Service Air header shall be Stainless steel. Impulse pipe for such applications shall have four-way valve. one port of the valve shall have an adaptor to connect flexible stainless steel braided nylon to the service air. Rating of the hose having a burst pressure 15 Kg/Sq.cm. four way valve shall have two position operations. One position for service and other one for purging. Required pressure guages shall be provided for monitoring of air pressure. Complete purging arrangement shall be integral to the enclosure and racks.

m) Power Supplies

Contractor 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.

n) Equipment Installation

Special attention shall be given in the piping layout to avoid air traps in liquid filled piping, or water pockets in piping.

o) 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 instrument 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, gasketted 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 blow down header. The connection between the blow down 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.

p) 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 6 mm OD 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.

5.04.02 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 shall be shop 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 IP-65 class prior to mounting them on open structures.

c) The following shall be provided for open type transmitter racks:

1. Rack shall be constructed from 6mm thick steel channel frame.
2. Canopy shall be of 3mm thick CRCA steel.
3. 2"NB Galvanised pipes shall be laid horizontally and supported at two end channels to mount transmitters/switches at accessible height.
4. Adequate support for Manifold, impulse pipe and cable tray to be provided and the same shall be adjustable.
5. Individual Instrument blowdown line shall be connected to the common blowdown drain header through regulating globe type blowdown valves. The common blowdown drain header shall be 2" NB ASTM A106, Sch-80 Gr. C installed at a slope of 1:25

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

ii) Power supply for receptacles and lighting shall be arranged. Power supplies for miscellaneous devices shall be provided with MCB located within the rack JB. MCBs shall be mounted in blocks. MCB ratings will be given on electrical schematic 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 5.01.01 (j) above

h) Service Air

Same as for closed type transmitter rack. Refer 5.01.01 (k) above

i) Power Supplies

Same as for closed type transmitter rack. Refer 5.01.01(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 the 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 5.01.01 (n) above

l) Instrument Tubing

Same as for closed type transmitter rack. Refer 5.01.01 (o) above

5.04.03 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 though 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.

5.04.04 Junction Box

Junction boxes shall be of metallic construction.

a) Junction box shall be provided with front opening type cover. Junction box shall be of sheet steel construction with thickness not less than 2 mm. Junction box shall be complete with DIN rail mounted terminals, MCB, receptacles and earth bar. Earth bar shall be made of tinned copper of 25 X 6 MM size. Earth stud shall be furnished for safety grounding.

b) Terminals shall be screwless cage-clamp type and 20% spare terminals shall be furnished. Power terminals shall be screw type.

5.00.00 ANALYZERS & SAMPLING SYSTEM SPECIFICATIONS

All the analysers shall be microprocessor based with drift free, auto compensation and calibration provision. Analyzers shall have facility to programme from the front key pad and shall have necessary fault diagnostic features. Each analyzer shall have a self-contained readout meter.

The general technical specification of the analyzers is provided in this section. The system design should ensure that the pH and conductivity transmitters are mounted close to the respective sensors.

Multichannel analyzers are acceptable only for Silica, Sodium, Chloride & Phosphate measurements, as these measurements are more to monitor the trend. In all other measurements, such as Conductivity, pH, Dissolved Oxygen & Hydrazine measurements, Single channel analyzers must be offered.

Silica analyzers must be able to have analysis cycle completed within less than 10 minutes. A grab sampling facility is a must with the silica analyzer, as this helps to compare lab readings of a known silica solution with the analyzer reading. Silica analyzer should be able to display silica concentration, Alarm status, Calibration Constants, channel selection, current outputs, diagnostics, trend curves, historical data. In the diagnostics the analyzer should give information such as Lack of Sample / Reagent, Calibration solution & Calibration error, hardware failure etc.

Bidder in his offer shall indicate the sample flow requirement of each analyzer and the total quantity of cooling water required for the system.

5.01.00 Conductivity Analyzer

A. Sensor

01.	Type of Cell	:	Flow through type / removable type (withdrawable with sealing valve)
02.	Conductivity Range	:	As per instrument schedule
03.	Cell Constant	:	0.01 / 0.1 / 1.0 depeding upon range
04.	Temperature Compensation	:	Manual and Automatic (Integral) upto 0-100°C with PT-100 Sensor
05.	Process Connection	:	Screwed
06.	Wetted Parts	:	Electrodes : SS 316L or better Insulators : .KYNAR & VITON or better
07.	Pressure Rating	:	10 kg/cm^2
08.	Accessories	:	Vessel (SS 316) with ½" NPT connection.
09.	Cable	:	Upto transmitter in flexible conduct

B. Transmitter

01.	Type	:	Microprocessor based, Single stream with multi-range facility
02.	Mounting	:	Flush Panel

03.	Protection Class	:	IP-55 or better
04.	Output	:	4-20 mA DC (isolated) to a load of 600 ohms (min.)
05.	Display		i) Digital Display of process variable in Engineering Unit, Temperature, Alarm Status. ii) Back lit LCD iii) Character Height 12 mm
06.	Zero / Span Adjustment	:	Front Panel Membrane type Keyboard.
07.	Temperature Compensation	:	Manual or Automatic - selectable through keyboard
08.	Diagnostic	:	Self diagnostic programme for electronics, measuring electrode, open wiring etc.
09.	Alarm	:	Dual alarm set point (2 SPDT, high & low), hysterisis and time delay adjustable from membrane keyboard. Switch contact rating of 5 Amp, 240 VAC / 0.2 Amp, 220 VDC
10.	Enclosure	:	Polycarbonate or better ; Enclosure class IP-55 or better
11.	Cable Termination	:	Internal (cable entry through conduit)
12.	Accuracy	:	$\pm$ 1.0 % of measured range
13.	Response time	:	Less than 5 sec.
14.	Stability	:	$\pm$ 1.0 % of full scale / month non-cumulative
15.	Power Supply	:	240 V AC, 50 Hz UPS
16.	Operating Temp.	:	0 -50°C
17.	Accessories	:	a) For cation conductivity analyzer Dual Ion-Exchange column, resin, etc. (minimum 12 months requirements). b) Phenolic Nameplate, cable gland c) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memeory)

5.01.00 pH Analyzer

A. Sensor

01.	Type of Cell	:	Measuring and reference electrode combination with flow through type (polypropylene flow chambers).
02.	Process Connection	:	Screwed
03.	Type of measurement	:	Combination electrode
04.	Temperature Compensation	:	a) Automatic (Integral) upto 0-100°C with PT-100 Sensor b) Manual Temperature Compensation
05.	Preamplifier	:	Integral or separate
06.	Range	:	0-14 pH
07.	Measuring Electrode	:	Glass
08.	Liquid Junction	:	Ceramic/Kyner or equivalent
09.	Pressure Rating	:	10 kg/cm^2
10.	Accessories	:	Vessel (SS 316) with ½" NPT connection
11.	Cable	:	Upto transmitter in flexible conduct

B. Transmitter

01.	Type	:	Microprocessor based, Single stream with adjustable range facility
02.	Mounting	:	Flush Panel
03.	Protection Class	:	IP – 55 or better
04.	Output	:	4-20 mA DC (isolated) to a load of 600 ohms (min.)
05.	Display		i) Digital Display of process variable in Engineering Unit, Temperature, Alarm Status. ii) Back lit LCD iii) Character Height 12 mm
06.	Calibration	:	Two-point calibration with standard buffer solutions.
07.	Temperature	:	Manual or Automatic - selectable through

	Compensation		keyboard
08.	Diagnostic	:	Self diagnostic for "Calibration requried"/ "Calibration O.K.", electrode checking etc.
09.	Alarm	:	Dual alarm set point (2 SPDT, high & low), hysterisis and time delay adjustable from membrane keyboard. Switch contact rating of 5 Amp, 240 VAC / 0.2 Amp, 220 VDC
10.	Enclosure	:	Polycarbonate or better; Enclosure class IP-55 or better.
11.	Cable Termination	:	Internal (cable entry through conduit)
12.	Accuracy	:	± 0.2% of FSD or better"
13.	Repeatability	:	± 0.02 pH or better
14.	Response Time	:	Less than 2 seconds or better
15.	Stability	:	± 0.001 pH / week
16.	Power Supply	:	240 V AC, 50 Hz UPS
17.	Operating Temp.	:	0 - 50°C
18.	Accessories	:	a) Ultrasonic Electrode Cleaner for uncleaned water. b) Phenolic nameplate giving tag number, service, cable gland etc. c) Pre-amplifier, special cable, ultrasonic cleaner, etc. d) Buffer tablets. e) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memeory)
19.	Preferred feature		Self cleaning type sensor

5.02.01 Silica Analyzer

01.	Type	:	Colorimetric Analyzer, gravity / pumped feed Microprocessor based
02.	Operating range	:	As per instrument schedule
03.	Output	:	4-20 mA DC (isolated) into 600 ohms

04.	Readout	:	Digital Indicating meter for direct readout
05.	Accuracy	:	±1% of F.S.D or better
06.	Reproducibility	:	± 2% of F.S.D. or better
07.	Calibration	:	Manual & automatic
08.	Cycle time	:	Less than 10 min or better
09.	Operating ambient temperature	:	0-45 ^{O}C
10.	Ambient humidity	:	Up to 95% relative humidity
11.	Enclosure	:	Polycarbonate or better; Enclosure class IP-55 or better
12.	Mounting	:	Flush panel
13.	Life of light source	:	9,000 hours (approx.)
14.	Power supply	:	240V, 50 Hz, 1 Phase UPS
15.	Alarm Facility	:	2 HI & 2 LO independently adj. over span. Contact rating, 5A, 240 V AC / 0.5A, 220 V DC.
16.	Alarm for	:	a) Monitor mal-function b) Monitor on standby c) Monitor auto-zeroing d) Concentration high e) Loss of sample f) Concentration low g) Loss of reagent
17.	Preferred features	:	a) Hi and Lo alarm LED visible from front. b) Power supply on/failure LED visible from front.
18.	Accessories	:	a) Reagent cabinet b) Sample strainer c) Reagent Reservoir etc. d) Phenolic name plate e) Reagents & consumables f) Special cables upto transmitter with flexible conduit g) Serial interface (RS 232) for data logger download to PC (No data loss after

power failure, all data shall be saved in non-volatile memeory)

5.03.00 Sodium Analyzer Assembly

01.	Type of Cell	:	Flow Through ion-selection electrode
02.	Flow Chamber	:	Plexi Glass Body or equivalent
03.	Operating Range	:	As per instrument schedule
04.	Measuring Electrode	:	Sodium Selective Glass Electrode
05.	Output	:	4-20 mA DC (isolated) into 600 ohms
06.	Temperature Compensation	:	Automatic upto 45 deg.C
07.	Read Out	:	Digital Indicating meter
08.	Accuracy	:	< 5% of reading
09.	Response Time	:	2 minutes or better
10.	Operating Ambient Temperature	:	0 - 45 ^{O} C
11.	Ambient Humidity	:	Up to 95% relative humidity
12.	Mounting	:	Flush Panel
13.	Enclosure	:	Polycarbonate or better; Enclosure class IP-55 or better
14.	Calibration	:	Automatic
15.	Power Supply	:	240V, 50 Hz, 1 Phase UPS
16.	Alarm Facility	:	2 HI and 2 LO independently adjustable over span. Contact rating, 5A, 240 V AC / 0.5A, 220 V DC.
17.	Accessories (Preassembled, pre-wired and pre-tubed in enclosure)	:	i) Phenolic tag plate etc. ii) Sample filter. iii) Pressure regulator & flow meter iv) Automatic calibration kit v) Reagents and consumables vi) Special cables upto transmitter with flexible conduit vii) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memeory)

5.04.00 Phosphate Analyzer Assembly

01.	Type of Cell	:	Flow Through
02.	Flow Chamber	:	Plexi Glass Body or equivalent
03.	Operating Range	:	As per instrument schedule
04.	Measurement Principle	:	Colorimetric Detection system
05.	Output	:	4-20 mA DC linear
06.	Read Out	:	Ditgital Indicating meter
07.	Accuracy	:	$\pm$ 5% of Scale Range or better
08.	Response Time	:	90% in 10 minutes or better
09.	Operating Ambient Temperature	:	0 - 45 ^{O} C
10.	Ambient Humidity	:	Up to 95% relative humidity
11.	Mounting	:	Flush Panel
12.	Calibration	:	Manual through Zeroing solution
13.	Power Supply	:	240V, 50 Hz, 1 Phase UPS
14.	Alarm Facility	:	2 HI and 2 LO independently adjustable over span. Contact rating, 5A, 240 V AC / 0.5A, 220 V DC.
16.	Enclosure	:	Polycarbonate or better; Enclosure class IP-55 or better
17.	Accessories	:	i) Phenolic tag plate etc. ii) Sample filter. iii) Pressure regulator & flow meter iv) Automatic calibration kit v) Reagents and consumables vi) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memeory)

5.05.00 Hydrazine Analyzer

01.	Type	:	Electrochemical
02.	Operating Range	:	As per instrument schedule
03.	Output	:	4-20 mA DC linear & 1-5 volts

	04.	Readout	:	Digital Indicating Meter, linear read-out
	05.	Accuracy	:	±2% of FSD or better
	06.	Reproducibility	:	2% of FSD or better
	07.	Drift	:	2 ppb/month or better
	08.	Temperature Compensation	:	Automatic up to 45 ^{O} C
	09.	Operating Ambient Temperature	:	0-45 ^{O} C (maximum)
	10.	Response Time	:	1 minutes or better
	11.	Mounting	:	Flush Panel
	12.	Enclosure	:	Polycarbonate or better; Enclosure class IP-55 or better
	13.	Pressure Rating	:	As required
	14.	Power Supply	:	240V, 50 Hz, 1 Phase UPS
	15.	Alarm Facility	:	2 HI and 2 LO independently adjustable over span. Contact rating, 5A, 240 V AC / 0.5A, 220 V DC.
	16.	Preferred Feature	:	i) 2 Hi and LO alarm LED visible from front ii) Power supply on/failure LED visible from front
	17.	Accessories	:	i) All chemical reagents for 12 months operation etc. ii) Phenolic nameplate etc. iii) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memeory)

5.06.00 Dissolved Oxygen Analyzer

	01.	Type	:	Electro-chemical, Microprocessor based.
	02.	Range	:	As per approved instrument schedule
	03.	Type of Cell	:	Flow through sampling type (continuous)
	04.	Enclosure	:	Polycarbonate or better; Enclosure class IP-55 or better
	05.	Output	:	4-20 mA DC isolated to a load of 600 Ohms (minimum)
	06.	Temperature		

		Compensation	:	Automatic up to 45°C
	07.	Ambient Temp.	:	45 °C
	08.	Readout	:	Digital Indicating meter
	09.	Accuracy	:	Better than ±4% of full scale for Transmitter
	10.	Sensor Response Time	:	90% in 30 seconds or better
	11.	Mounting	:	Flush panel
	12.	Readable Distance	:	3 meters (minimum)
	13.	Power Supply	:	240 V AC, Single Phase, 50 Hz UPS
	14.	Alarm Facility	:	2 HI & 2 LO independently adjustable over entire span. Contact rating, 5A, 240 V AC / 0.5A, 220 V DC.
	15.	Preferred Feature	:	a) HI & LO Alarm LED visible from front. b) Power supply on/failure LED visible from front. c) In-built calibration facility.
	16.	Accessories	:	a) Phenolic nameplate giving tag no., service etc. b) Reagent Cabinet (if applicable) c) Reagent Reservoir (if applicable) d) Other as per requirement including piping etc. e) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memeory)

5.07.00 Chloride Analyzer

	01.	T y p e	:	Electro-chemical, Microprocessor based.
	02.	Range	:	As per approved instrument schedule
	03.	Type of Cell	:	Chloride Ion Selective Electrode
	04.	Enclosure	:	Polycarbonate or better; Enclosure class IP-55 or better
	05.	Output	:	4-20 mA DC isolated to a load of 600 Ohms (minimum)
	06.	Temperature Compensation	:	Automatic with Pt 100

07.	Ambient Temp.	:	45 °C
08.	Readout	:	Digital Indicating meter
09.	Accuracy	:	± 2% or better
10.	Reproducibility	:	<3%
11.	Detection Limit	:	0.5 mg/l or better
12.	Analysis Time	:	5 minutes (max)
13.	Cycle time	:	Adjustable
14.	Calibration	:	Manual and automatic
15.	Mounting	:	Flush panel
16.	Readable Distance	:	3 meters (minimum)
17.	Power Supply	:	240 V AC, Single Phase, 50 Hz UPS
18.	Alarms	:	1 HI, 1 LO and 1 system alarm Contact rating, 5A, 240 V AC / 0.5A, 220 V DC.
19.	Control accessories	:	a) Sample level detector b) Reagent level detecor c) Calibration solution level detector d) Automatic sample, rinse and drain valve e) Pump for calibration solution f) Pump for reagent solution
20.	Accessories	:	a) Phenolic nameplate with tag no., service etc. b) Reagent solution tank c) Calibration solution tank d) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memeory)

6.00.00 DESIGN CRITERIA

This section lays down the general design criteria to be adapted in designing the Control & Instrumentation system of the plant.

6.01.00 General Requirements

6.02.00 Instrumentation, control and automation devices and accessories shall be designed with the following considerations:

a) Stable in spite of temperature fluctuations.

b) Able to withstand high humidity.

c) Weather proof.

d) Dust proof.

e) Corrosion resistant.

f) Erosion resistant.

g) Able to withstand high vibration.

h) Easily accessible for operation & maintenance.

6.03.00 Parts subject to high pressure, temperature or other severe duty shall be of materials and construction suitable for the service conditions and long operating life.

6.04.00 Components of instruments, control devices, accessories, piping etc. which contact steam, condensate or boiler feed water shall be manufactured from copper-free materials.

6.05.00 Instrument Accuracy, Standard Scales and Ranges

6.05.01 Instrument Accuracy

Instruments shall meet the following general requirements.

a) Pressure measurement shall be linear with respect to the measured pressure.

b) Flow meter shall meet the specified accuracy criteria when operating between 25 and 100 % of full-scale flow. The accuracy shall include the effect of errors in the differential head measuring device, square root converter and signal generator.

c) Level measurement shall be linear with respect to the measured level based on a water specific gravity of 1.00.

d) Wherever the measured parameter is influenced by process pressure & temperature, required compressibility correction shall be introduced.

6.05.02 Instrument Scale Displays

a) All displays shall be in engineering units. Instrument scales displayed on screen will have graduations with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable.

b) Pressure instrument shall have the unit suffixed with ‘a’ or ‘g’ to indicate absolute or gauge pressure, respectively.

c) Scales and charts of all instruments shall have linear graduations

6.05.03 Instrument Ranges

Instrument range shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% for flow measurements. Deviation indicators shall have the null position at mid scale. The normal operating parameter shall be identified with a clear green mark.

6.11.00 Burn-In And Elevated Temperature Test

Solid-state equipment / system shall be certified to be tested for a minimum period of 168 hours continuously under power. Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies.

6.12.00 Elevated Temperature Test

a) During the first 48 hours the ambient temperature shall be maintained at 50° C and the equipment shall be made to repeatedly perform operations it will be expected to perform in service with loads on various components being equal to those which will be experienced in actual service.

b) The 48 hours test period shall be continuous but shall be divided into four 12-hour segments. The power supply voltage during each 12 hours segment shall be nominal voltage for 11 hours; followed by 110 percent of nominal voltage for 30 minutes; followed by 90 percent of nominal voltage for 30 minutes.

c) During the elevated temperature test the cubicle doors shall be kept closed and inside temperature in the zone of highest heat dissipating

component /module shall be monitored. Temperature rise inside the cubicle shall not exceed 10 Deg.C above the ambient temperature of 50 Deg.C.

6.13.00 Burn in Test

The 48 hours elevated temperature test shall be followed by 168 hours of burn in test at normal operating temperature. This test shall also be conducted as per above procedure.

6.14.00 Panels, Cubicles and Enclosures

6.14.01 General

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

b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.

c) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the CRCA steel for UCP / backup panel and other panels/cabinets shall be as described in Section VII of this volume of the specification. Panels and cabinets shall be of adequate strength to support mounted components during shipment

and to support a concentrated load of 100 Kilograms on their top after erection.

d) Panel /cabinet shall have eyebolt on top for lifting.

e) Mounting , wiring , powering of all items to be mounted / installed on desks irrespective of the source of procurement shall fall in the scope of erection of Bidder ,this shall include freeissue items furnished by Owner.

6.14.02 Surface Preparation and Painting

Sheet metal exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below:

a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.

b) Two spray coats of epoxy primer □urface shall be applied to all exterior and interior surfaces, each coat of primer □urface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The Min. Paint shade thickness at exterior & Interior shall be 80 to 100 Microns.The finish colors for exterior and interior surfaces shall conform to the following shades:

i) Exterior : RAL 7032

ii) Interior – Brilliant White (Preferred) / RAL 7032.

c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

6.14.03 Wiring

Wiring within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following :

a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.

b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.

c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.

d) Internal wiring shall be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.

e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low mili volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.

f) All low-level signal cables shall be separately bundled from control cable.

g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.

h) Shield wires shall be terminated on separately.

i) Common connections shall be limited to two wires per terminal. Looping of wires for power distribution in the panel to be avoided. Busbars to be provided for Power distribution".

j) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue to the conductor.

k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which will

impede the opening of covers or obstruct access to leads, terminals or devices.

l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.

m) Panels /cabinets /desks shall be provided with removable gasketted cable gland plates and cable glands. Split type grommets shall be used for prefab cables.

n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

o) Wire sizes used for internal wiring shall not be lower than the followings :

Control wiring (switches, pushbuttons etc.)	: 1.5 Sq.mm
Power supply /receptacle /illumination wiring	: 2.5 sq. mm or higher as per load

4-20mA DC current and low voltage signal upto 48V DC	: 0.5 Sq. mm

p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

6.14.04 Grounding

a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.

b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 6 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.

c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.

d) Circuits requiring grounding shall be individually and directly

connected to the panel ground bus.

e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.

f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

6.15.00 Panel / Cabinet/ Desk/ Enclosures / junction boxes & instruments Environmental Protections

a) Panels, cabinets, desks, distribution boxes, racks ,junction boxes, terminal boxes , instruments and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table.

SL. NO.	LOCATION	ENCLOSURE TYPE
1.	Indoor type non- ventilated enclosure in non-hazardous area	IP-54
2.	Indoor type ventilated enclosure in non-hazardous area	IP -42
3.	Enclosure in Air conditioned area	IP-32 with suitable canopy at top to prevent ingress of dripping water.
4.	Outdoor type in non-hazardous areas	IP-65 with anticorrosion coating.
5.	Outdoor in hazardous areas	As per requirements of the NEC Code for the location

b) The construction of electrical enclosures located in areas subject to conditions classified in the National Electrical Code (NEC) as hazardous shall be of a type designated suitable for the environment in which they are located.

6.16.00 Terminal Blocks

a) Terminals shall be chromated galvanized DIN rail mounted screwless cage clamp type or maxi termi type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm^2. Terminal blocks shall conform to IEC 947-7-1.

b) The characteristics of the terminal blocks shall be as follows.

- High contact force, independent of conductor cross-section and large contact surface area.
- Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
- Inspection and maintenance free (resistant to thermal aging and vibration)
- Low and constant voltage drop

c) Material of the clamping yoke of screwed terminals shall be electroplated, chromated, case hardened steel with high strength clamping screw. For screwless terminals, the tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.

d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.

e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.

f) Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.

g) At least 20 percent spare unwired terminals shall be provided for all panels /cabinets /desks /junction box etc... This shall be in addition to 20% spare wired terminals of spare IO channels.

h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.

i) For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.

j) Other requirements of the terminal blocks are as follows:

i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.

ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.

iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.

iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.

v) Where more than one connection to a terminal block is required, two tier terminals shall be used.

vi) The terminal blocks for Power, control and signal cable terminal block shall be seperate with seperate colour coding for ease in recognition..

7.00.00 METERING BASES AND CHART UNITS

The following system of units shall be followed for various displays and scales unless otherwise mentioned:

i)	Pressure	: Kg/cm^2
	Differential Pressure	: mm of H_2O column / Kg/cm^2
ii)	Draught	: mm of H_2O column
iii)	Vacuum	: Kg/cm^2 (abs)/mm of Hg column

iv)	Temperature	: Degree Celsius (^{O} C)
v)	Flow (Steam, Water)	: Tonnes / hr, M^3/Hr
vi)	Flow (Oil)	: M^3 / Hr, Liter/Hr
vii)	Flow Air	: Tonnes / hr / M^3 / Hr.
viii)	Density	: gms / c.c.
ix)	Level	: mm /%
x)	Conductivity	: Micro Siemens / cm
xi)	Gas Analyzer	: Percentage by weight or as specified in respective case.
xii)	Dissolved Oxygen / Silica / Sodium	: ppm /ppb

8.00.00 PROCESS CONNECTION & INSTRUMENT HOOK UP

8.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.

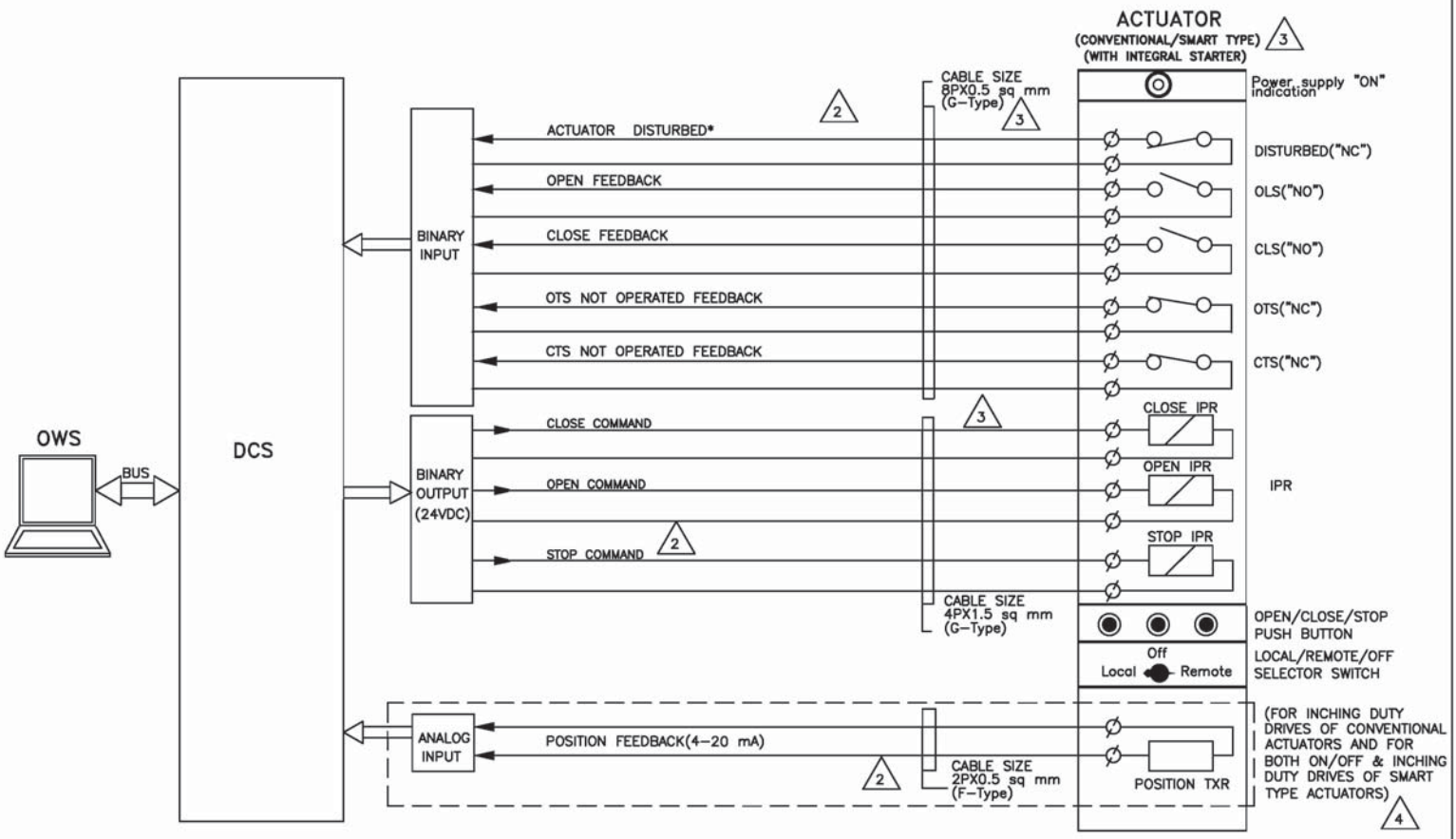
8.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.

8.03.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards.

SIGNL EXCHANGE BETWEEN DRIVES & DCS

383567/2021/PS-PEM-MAX

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)

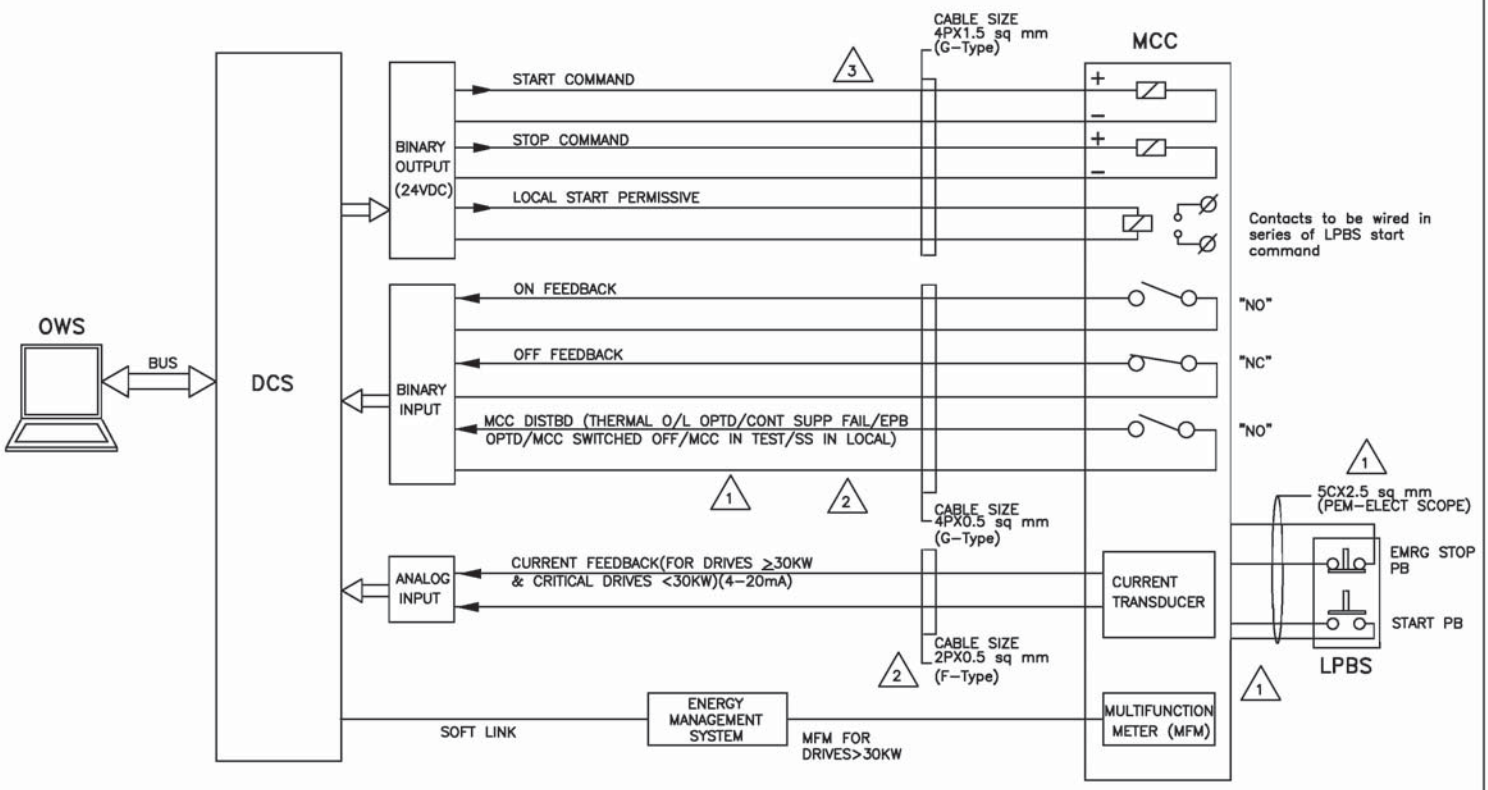


NOTE:

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

BHEL	PROJECT: 1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	DRG.NO.	PE-DM-445-145-I002
		DATE	15.03.2021
	TITLE DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	04
		SHT	7 OF 11

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED) △1

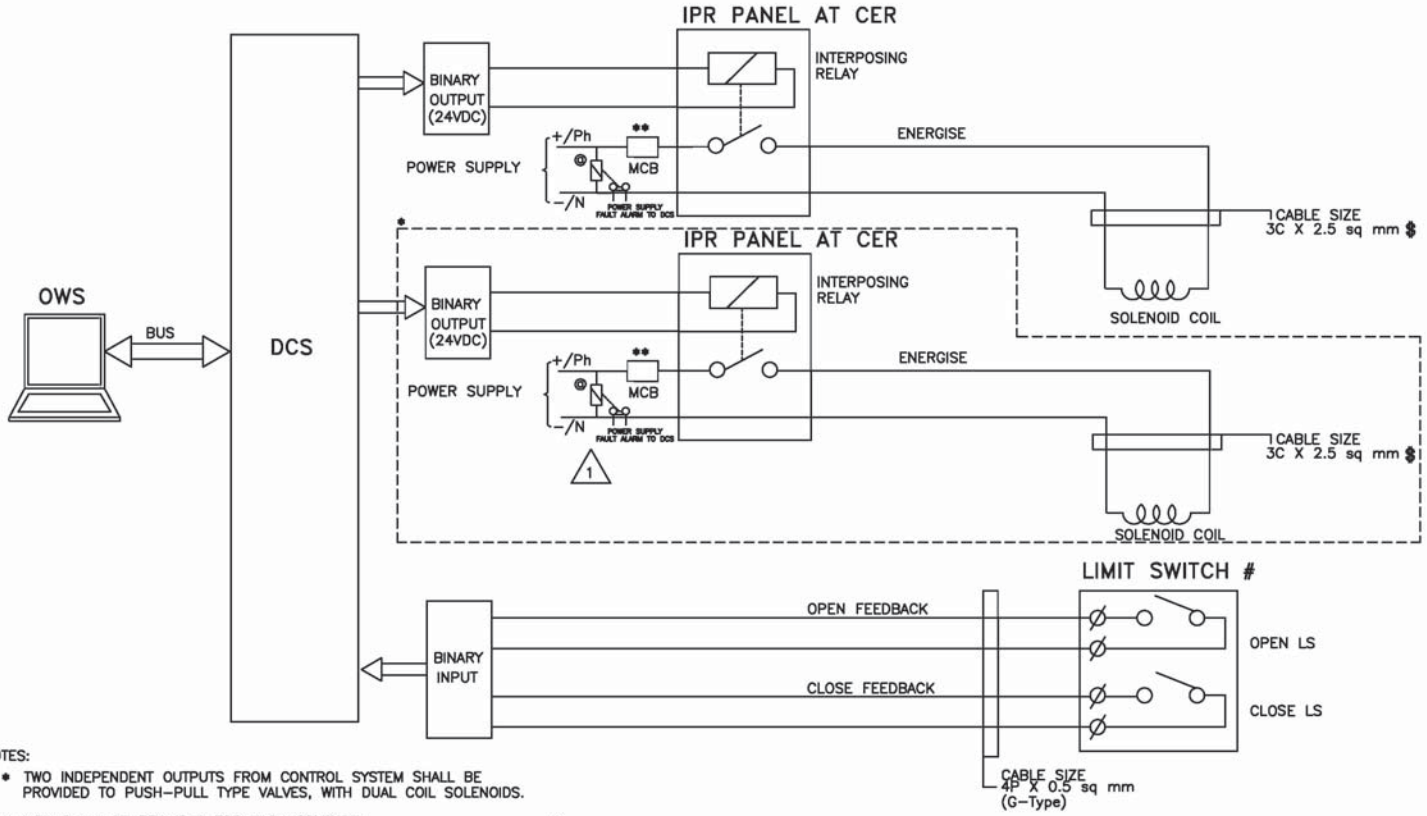


NOTES:

REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL CRITICAL LT DRIVES △2

PROJECT:	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	DRG.NO.	PE-DM-445-145-I002
		DATE	15.03.2021
TITLE	DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)	REV.NO.	04
		SHT	8 OF 11

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

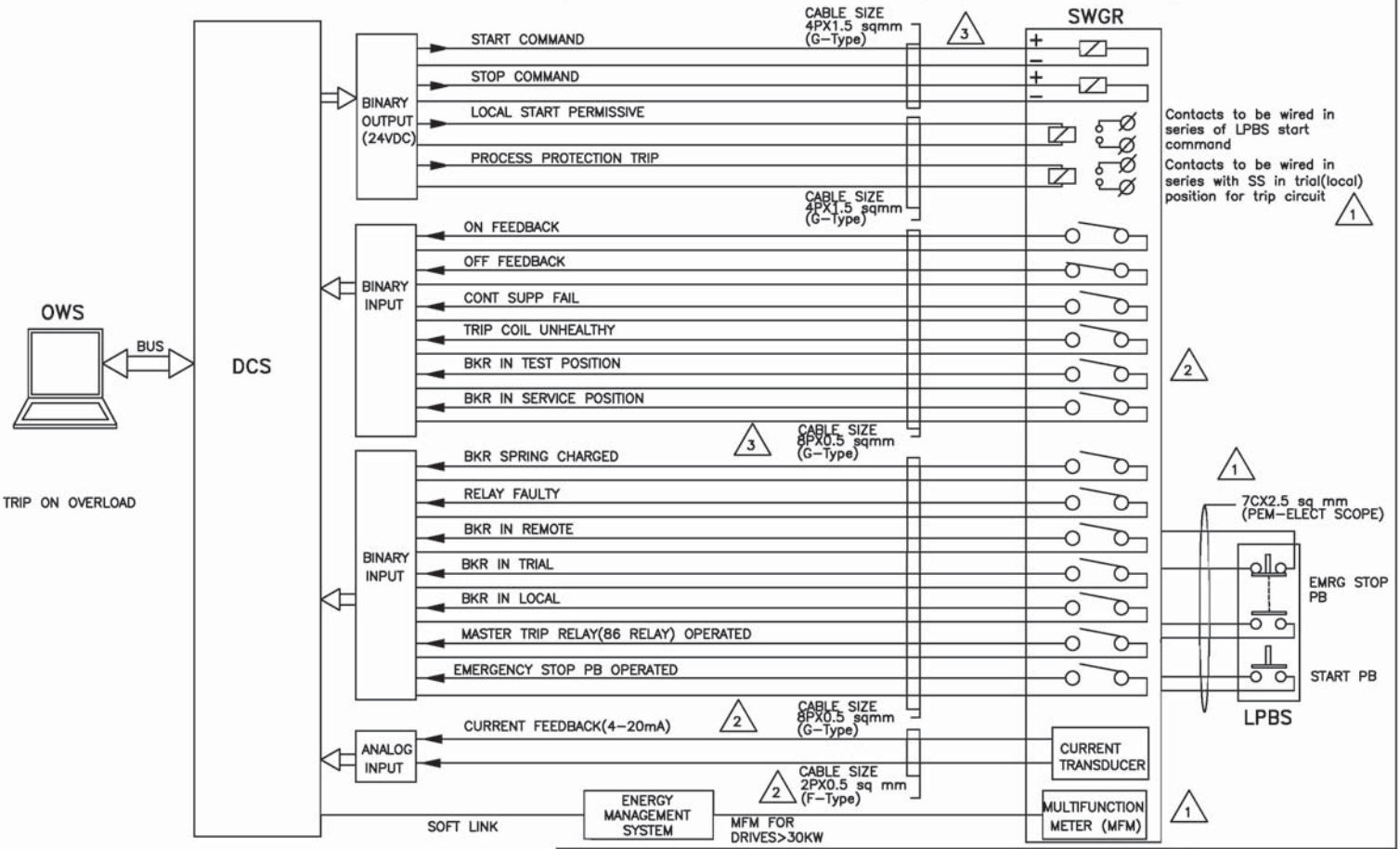


NOTES:

- * TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.
- ** MCB SHALL BE PROVIDED FOR EACH SOLENOID
- # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL/ PNEUMATIC VALVE. (1)
- @ COMMON FOR ALL SOLENOID VALVES SIMILAR COIL VOLTAGE RATING PER PANEL. (2)
- $ POWER CABLE CROSS SECTION SHALL BE AS PER CABLE SIZING CALCULATION. (3)

BHEL	PROJECT: 1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	DRG.NO.	PE-DM-445-145-I002
		DATE	15.03.2021
	TITLE: DDCMIS INTERFACE FOR SOLENOID DRIVE	REV.NO.	04
		SHT	9 OF 11

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



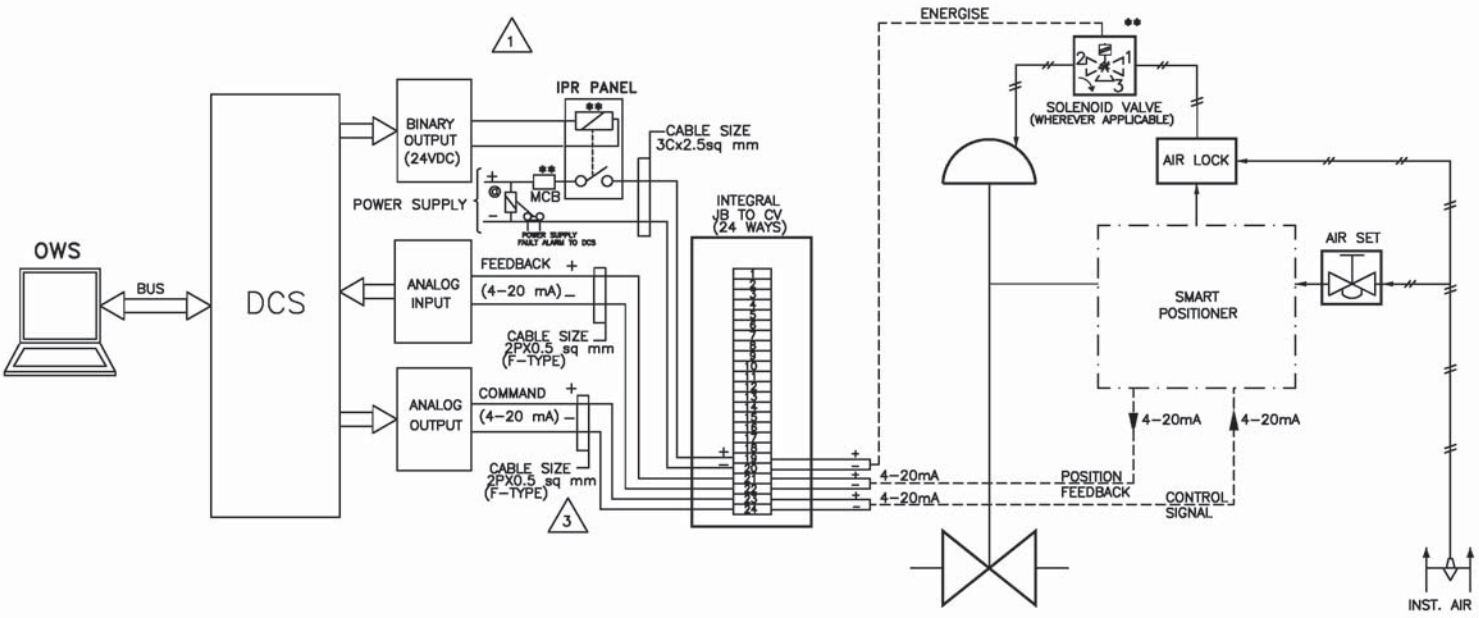
NOTES:

REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL HT AND CRITICAL LT DRIVES (1)

PROJECT:	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	DRG.NO.	PE-DM-445-145-I002
		DATE	15.03.2021
TITLE	DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	REV.NO.	04
		SHT	10 OF 11

383567/2021/PS-PEM-MAX

DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

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

@ COMMON FOR ALL SOLENOID VALVES PER PANEL.

1 REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL MODULATING DRIVES

BHEL	PROJECT: 1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	DRG.NO.	PE–DM–445–145–I002
		DATE	15.03.2021
	TITLE: TYPICAL HOOK–UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	REV.NO.	04
		SHT	11 OF 11

INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

11.00.00 INSTRUMENTATION CABLES

11.01.00 General Requirements

11.01.01 Bidder shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under his scope.

11.01.02 Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Bidder.

11.01.03 Other type of cables like co-axial cables for system bus, cables for connection of peripherals etc. (under Bidder's scope) are also to be furnished by the Bidder.

11.01.04 Bidder shall supply all cable erection and laying hardware like cable trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.

11.01.05 All instrumentation cables covered in this specification shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and its amendments read along with this specification.

11.01.06 The thermocouple extension cables shall be of Two pair/multi pair, twisted & shielded, PVC insulated, FRLS PVC sheathed and compatible for the type of thermocouples employed. The material of conductor shall be as per ANSI MC-96.1.

paired instrumentation cable acceptable

11.01.07 Traid cables shal be used for all RTD (3-wire) measurements. In case of 4-wire RTD, 2 pair instrumentation signal cables shall be used.

11.01.08 All cables near high temperature zone like burner front devices, metal temperature thermo-couples on main steam & turbine casing etc. shall be high temp cables, which shall be terminated at a junction box in normal temperature zone. Thermocouple extension cables and copper conductor cables for high temperature applications shall be with insulation of individual conductor and outer sheath of extruded FEP (i.e., Teflon) as per VDE 0207 Part 6 and ASTMD 2116. The thickness of insulation shall be 0.5 mm nominal (i.e., 0.4 mm minimum). These cables shall be single/ multipair, twisted & shielded.

11.01.09 Cable accessories such as harnessing components, markers, bedding, cable joiner, binding tape etc. shall have flame retardant quality.

11.01.10 The thickness of outer sheath shall be as per the guidelines given in VDE 0816. Thickness of outer sheath shall not be less than 1.8 mm in any case. Allowable tolerance of overall diameter of the cables shall be ± 2 mm max. over the declared value in technical data sheets. The variation in diameter and the ovality at any cross section shall not be more than 1.0 mm.

11.01.11 The Cables shall be supplied in non returnable standard seasoned drums. The drum length shall be 1000m (± 5%) up to & including 8 pairs and 500 m (± 5%) above 8 pairs. Drum shall be anti rodent, anti termite and smooth finish. Both ends of cable shall be capped by means of non hygroscopic sealing material.

11.01.12 Durible marking shall be provided on the outer sheath of the cable at intervals not exceeding 5 metres. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs / type of compensating /extension cable, Analog or Binary), Insulation material, FRLS etc.

Sequential length marking shall also be provided at every metre interval on outer sheath of cable.

11.01.13 Bidder shall furnish all documentary evidence including cross-sectional drawings, test certificates to substantiate the suitability of cables offered for different applications. Bidder shall also clearly bring out the application wise details for each type of cable offered.

11.01.14 All prefabricated cables shall have 10% spare cores which will not be connected to pin connectors.

11.01.15 All the instrumentation cables i.e. twisted and shielded multipair cables, compensating cables, pre fabricated cables etc. shall be flame retardant low smoke and low halogen (FRLSH) type.

11.01.16 For all Digital Output (DO) signal from DCS or PLC, Minimum 1.5 Sq mm cable shall be used, except for Solenoid valves where 2.5 Sqmm cable shall be used. Moreover, bidder shall submit the calculations for selecting the cable size.

11.02.00 Instrumentation Cable Specifications

11.02.01 INSTRUMENTATION MULTI PAIRED SIGNAL CABLE

01.	Conductor type	:	Multi-stranded annealed tinned high conductivity copper
02.	Conductor size	:	0.5 / 1.0 / 1.5 Sq.mm (as required)
03.	Conductor resistance	:	39 Ω/Km/18 Ω/Km/12 Ω/Km
04.	Conductor Insulation	:	Extruded PVC meeting the requirements of VDE 0207 Part 4 compound Y I3. Insulation thickness for individual core shall be between 0.28 and 0.35 mm for 0.5 mm^2 cables, 0.5 to 0.6 mm for 1.0 mm^2 cables and 0.8 to 0.9 for 1.5 mm^2 cable.
05.	Voltage Grade	:	225 V (peak value)
06.	Twisting	:	Twin twisted with lay of 50 mm (max)
07.	Twisting Direction	:	All pairs in the same direction. Lapped to form bunch with mylar tape.
08.	Screen (Pair & Overall)	:	Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyster tape shall be

			applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. Analog signals - Individual pair & overall shield. Binary signals - overall shield.
09.	Drain wire	:	Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm). Separate drain wire for individual pair shield (wherever applicable) as well as overall shield.
10.	Inner Sheath	:	Extruded PVC (compound YM1) as per VDE 0207 Part 5 (anti rodent, anti termite & moisture resistant properties) and shall be of flame retardant low smoke (FRLS) type
11.	Fillers	:	Non metallic flame & moisture retardant
12.	Armouring	:	GI wire / strip
13.	Outer Sheath	:	Extruded PVC (compound YM1) as per VDE 0207 Part 5 and shall be of flame retardant low smoke low halogen (FRLSH) type
14.	Temperature Range	:	70^{O}C (continous) except for high temperature resistant Teflon insulated cables which shall be suitable for continous operation at 205^{O}C
15.	Sheath colour	:	Inner- Black and Outer- Sky Blue
16.	Tests on outer sheath	:	a) Oxygen Index: Min.29% at room temp. (ASTMD-2863) b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I c) Temp Index : Min 250^{O} C (ASTMD-2863) d) Smoke Density Rating :Max.60% (ASTMD-2843). e) Complete cable assembly shall pass Swedish Chimney Test- as per SEN-4241475 AND Flammability Test as per IEEE-383.

f) Halogen Content Measurement as per ICEA T-33-655 (Permissible limit for halogen shall not be more than 0.2%)

17. High voltage test
a) Core to core - 1.5 KV for 1 min.
b) Core to screen - 1.0 KV for 1 min.
c) Screen to Armour – 1.0 KV for 1 min

18. Rodent & Termite repulsion test Presence of lead shall be confirmed

19. Colour of core insulation for Instrumentation Cable

PAIR	CORE	COLOR
1st	1st	Blue
1st	2nd	Red
2nd	1st	Gray
2nd	2nd	Yellow
3rd	1st	Green
3rd	2nd	Brown
4th	1st	White
4th	2nd	Black

Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

11.02.02 THERMOCOUPLE EXTENSION & COMPENSATING CABLE (TWO PAIR & MULTI-PAIR)

01. Conductor : Solid conductor

02. Conductor size : 16 AWG (1.31 Sq. mm)

03. Type : Kx (Extension) (Chromel Alumel),
Rx (Compensating) (Copper-Copper alloy),

04. Conductor Insulation : Extruded PVC meeting the requirements of VDE 0207 Part 4 compound Y I3. Insulation thickness for individual core shall be between 0.35 to 0.45 mm for 1.31 mm^2 cables

05. Voltage Grade : 225 V (peak value)

06.	Twisting	:	Twin twisted with lay of 50 mm (max)
07.	Twisting Direction	:	All pairs in the same direction. Lapped to form bunch with mylar tape.
08.	Screen (Pair & Overall)	:	Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyster tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.
09.	Drain wire	:	Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm). Separate drain wire for individual pair shield as well as overall shield.
10.	Inner Sheath	:	Extruded PVC (compound YM1) as per VDE 0207 Part 5 (anti rodent, anti termite & moisture resistant properties) and shall be of flame retardant low smoke (FRLS) type
11.	Fillers	:	Non metallic flame & moisture retardant
12.	Armouring	:	GI wire / strip
13.	Outer Sheath	:	Extruded PVC (compound YM1) as per VDE 0207 Part 5 and shall be of flame retardant low smoke low halogen (FRLSH) type
14.	Temperature Range	:	70^{O}C (continous) except for high temperature resistant Teflon insulated cables which shall be suitable for continous operation at 205^{O}C
15.	Sheath colour	:	Inner- Black and Outer- Yellow for Type Kx, Green for Rx.
16.	Tests on outer sheath	:	a) Oxygen Index: Min.29% at room temp. (ASTMD-2863) b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I c) Temp Index : Min 250^{O} C (ASTMD-2863) d) Smoke Density Rating :Max.60% (ASTMD-2843).

e) Complete cable assembly shall pass Swedish Chimney Test- as per SEN-4241475 AND Flammability Test as per IEEE-383.

f) Halogen Content Measurement as per ICEA T-33-655 (Permissible limit for halogen shall not be more than 0.2%)

g) Thermal EMF Test as per ANSI MC96.1

17. High voltage test
a) Core to core - 1.5 KV for 1 min.
b) Core to screen - 1.0 KV for 1 min.
c) Screen to Armour – 1.0 KV for 1 min

18. Rodent & Termite repulsion test Presence of lead shall be confirmed

19. Conductor material & sheath color for thermocouple extension /compensating cable as per ANSI MC 96.1

CABLE TYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
Kx	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
Rx	Green	Positive	Black	Copper
		Negative	Red	Copper Alloy

11.02.03 INSTRUMENTATION TRIAD CABLES

01. Conductor type : Stranded tinned Electrolytic copper

02. Conductor size : 1.0 Sq.mm

03. Stranding : 7 x 0.43 mm

04. Conductor Insulation : HRPVC Type-C, 0.6 mm thick

05. Twisting : Triad twisted with lay of 50 mm

06. Twisting Direction : All triads in the same direction. Lapped to form bunch with mylar tape.

07. Colour : Outer sheath colour shall be black for non-IS cable and light blue for IS cable.

Individual traid color code shall be Light blue-Brown-Black.

08.	Individual Pair Overall Shield mm thick).	:	Polyethylene coated aluminum foil with 100% coverage with 25% Overlap (0.06
09.	Drain wire	:	Annealed Tinned copper wire, Size 0.5 Sq. mm. minimum
10.	Inner Sheath	:	Extruded FR PVC, Thickness as per International Standard
11.	Armoring	:	N/A
12.	Outer Sheath	:	Extruded FR PVC, Thickness as per International Standard
13.	Rip Cord	:	Yes
14.	Operating Voltage	:	300 V / 500V R.M.S (Core to Earth / Core to Core.)
15.	Temperature Range	:	Up to 85 °C
16.	Electrical Characteristics Resistance	:	18.4 Ohms/Km (max.) at 20 ^{O}C
Mutual Capacitance at 1 kHz		:	a) Between adjacent cores 150 nf / Km. b) Between conductor and Screen 400 nf / Km
L/R ratio		:	25 µH/Ohms (max)
Insulation at 20^{0} C		:	100 M Ohms/Km (Min)
17.	Codes & Standards	:	a) IPCEA-S-61-402 b) IEC 332-1 ASTM-B-33
18.	Tests	:	a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863) b) Temp Index : Min 250 ^{O}C at 21Oxy. Ind. (ASTM-D-2863) c) Flammability Test : as per IEC 332 Part-I d) Swedish Chimney Test-S-424-1475 e) High Voltage Test :1.0 KV for1 Min

f) Type Test for material

19. No. of Triads : 2T, 6T, 12T

11.02.04 Cable parameters such as mutual capacitance between conductors, conductor resistance, insulation resistance, characteristic impedance, cross talk and attenuation figures at 20 deg. C (± 3 deg. C) for various types of cables as applicable shall be as specified in TABLE-1.

TABLE- 1

CABLE PARAMETERS

SL. NO.	PARAMETER / TYPE	TYPE – E, F	TYPE – G, I	TYPE – A, B & C	REMARKS
01.	Mutual Capacitance at 0.8 kHz (max.)	120 nF/Km.	100 nF/Km.	120 nF/Km.	
02.	Conductor Resistance (max.)	73.4 Ohm/km (Loop) For Type F, 13.3 ohm/km (loop) for Type E	73.4 ohm/km (loop)	26.6 ohm/km (loop)	
03.	Insulation Resistance (minimum)	100 M ohm/km	100 M ohm/km	100 M ohm/km	
04.	Cross-talk figure at 0.8 kHz (minimum)	60 dB	60 dB	60 dB	
05.	Characteristic Impedance (maximum) at 1 kHz	320 ohm	340 ohm	320 ohm	
06.	Attenuation at 1 kHz (maximum)	1.2 dB/Km for Type F; 0.8 dB/Km for Type E	1.2 dB/Km	1.2 dB/Km	

11.02.05 Identification of the cores & pairs shall be done with suitable colour coding & band marking as well as by numbering of cores/pairs as per VDE: 0815. The details of colour coding etc. shall be as approved by Owner during detailed stage. Also refer TABLE - 2 for description of various type of cables.

TABLE- 2

DESCRIPTION OF VARIOUS TYPES OF CABLES

SL. NO.	TYPE	CONDUCTOR SIZE IN SQ.MM	REMARKS
01.	A	1.31	Two pair shielded and twisted pair thermo-couple, extension cable, ANSI type Kx, solid alloy conductor.
02.	B	1.31	Two pair shielded & twisted thermo-couple, extension cable, ANSI type Sx, solid alloy conductor.
03.	C	1.31	Two pair shielded & twisted Heat resistant Teflon insulation & outersheath thermo-couple, extension cable, ANSI type Kx, solid alloy conductor.
04.	E	0.5	Two pair individual pair and overall shielded twisted pair instrumentation cable for both analog and digital signal to be used from field mounted instruments to local junction box.
05.	F	0.5	Multipair individual pair & overall shielded twisted pair instrumentation cable (4/8/12pair) for analog signals with stranded copper conductor.
06.	G	0.5	Multipair overall shielded & twisted pair instrumentation cable (4/8/12pair) for binary signals with stranded copper conductor.
07.	H	1.0	2 Triad / MultiTriad individual pair & overall shielded instrumentation cable (2/6/12Triad) for RTD signals with stranded copper conductor.
08.	I	0.5	Type F cable / type G cable with heat resistant Teflon insulation & outersheath for high temperature application.
09.	S	As per specific standard / requirement for each applicable	Multicore / multipair shielded cable for system specific cables like conductivity type level switches, system bus cable, flame scanner etc. as applicable.

11.03.00 Instrumentation Cable Interconnection and Termination Philosophy

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group JBs at strategic locations (where large concentration of signals are available, e.g. switchgear) is done and consequently cable with higher number of pairs are extensively used. JB's to be furnished under this specification shall be of 6/12/24/36/48 way. The material dimension and interior / exterior colour of JB's shall be subject to Owner's approval. The details of termination to be followed is mentioned in TABLE – 3 :

TABLE- 3

CABLE TERMINATION TO BE FOLLOWED

SL. NO	APPLICATION		TYPE OF TERMINATION		TYPE OF CABLE
	FROM (A)	TO (B)	END (A)	END (B)	
01.	Valves / Dampers Drive (Integral Junction Box)	Marshalling Cubicle / Local Group JB / Termination Control Cabinets / System Cabinets	Plug-in Connector	Post mounted Maxitermi / Cage Clamp type	G
02.	Transmitters, Process actuated switches to be mounted in LIE / LIR	Integral Junction Box of LIE / LIR	Plug-in Connector	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
03.	RTD Heads	Local Junction Box	Plug-in Connector	Maxitermi / Cage Clamp (Rail mounted) type.	H
04.	Thermocouples	CJC Box	Manufacturer's standard	Screwed / Cage Clamp Type	A,B,C*
05.	Local Junction Box, CJC Box, Int. Junction Box of LIE / LIR / Group JB / MCC / Switchgear	Marshalling Cubicle / Local Group JB / Termination / Control Cabinets / System Cabinets	Maxitermi / Cage Clamp (Rail mounted) type.	Post mounted Maxitermi / Cage Clamp type	F, G
06.	Local Junction Box, MCC / Switchgear	Group JB	Maxitermi / Cage Clamp (Rail mounted) type.	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
07.	Field mounted Instrument	Group JB	Maxitermi / Cage Clamp (Rail mounted) type.	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
08.	Marshalling Cubicle /	Electronic System	Post mounted Maxitermi /	Post mounted Maxitermi /	F, G

SL. NO	APPLICATION		TYPE OF TERMINATION		TYPE OF CABLE
	FROM (A)	TO (B)	END (A)	END (B)	
	Termination Cabinet	Cabinet	Cage Clamp type.	Cage Clamp type.	
09.	UCP mounted equipments	Post mounted Maxitermi / Cage Clamp type	Post mounted Maxitermi / Cage Clamp type.	Plug in Connector / Cage Clamp type (rail mounted)	F, G (with connector at one end)
10.	DCS/ PLC Cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Manufacturer Standard

NOTES :

01. For Sl. No. 05, 06, 07 & 08, normally 10% spare core shall be provided.

02. For analog signals individual pair shielding & overall shielding & for Binary signals only overall shielding of instrumentation cables shall be provided.

03 *For high temperature application only.

11.04.00 CONTROL & POWER CABLE

Bidder shall refer to Volume IIF of the electrical specification for detail.

11.05.00 OPTICAL FIBER CABLE

11.05.01 This specification defines the minimum general requirements for the Design, manufacture, supply, inspection, installation, testing & commissioning of optical fiber cables and accessories, such as fiber distribution (patch) panels, adapters, connectors, joint boxes, pigtails and other components, as required to complete the system. Bidder shall consider all related activities, such as cable stripping, cable entry in boxes and panels, cable fiber splicing/fusion, cable performance testing and other services, to achieve a properly documented and operational cable network. all Fibre Optic cables shall be Single Mode type.

11.05.02 Fiber Optic Cables shall be installed on cable tray, duct bank, cable trench installation as necessary. For outdoor applications the cable shall be armoured with Poly Ethylene sheathing. In all cases cable shall be routed through suitable grade HDPE permanently lubricated protection pipe as per IS 4984, IS 12235 & TEC.G/CDS-08 /01of suitable size @ 53% fill factor. Permanent route marking in FRP (Fibre Reinforced Plastic) material shall be provided at intervals not exceeding 5 meters for all FO cables layed outdoor buried under the ground.

11.05.03 The Optical Fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withstand temperature of about 80°C (continuous).

Fiber optic distribution panels shall be provided as required. The fiber optic distribution panels shall be of a standard wall mounted sheet metal enclosure type. Fiber optic distribution panels shall be equipped to secure optical fiber patch cables and pigtails to prevent damage during all operation and maintenance functions. In general splice enclosure are envisaged. However, if no optical fiber splice enclosures are implemented, than the fiber optic distribution panels shall be equipped with splice trays for storage and protection of fusion splice connections of single-mode fiber optic cable and pigtails. Each fiber optic distribution panel shall be fully equipped with 'SC' type bulk head connector sleeves or equivalent. Unused sleeve ports shall be equipped with reusable caps to prevent the intrusion of dust.

11.06.03 Pigtail and Patch Cord

All pigtails shall be factory SC-connectorized, and satisfy specified performance for optical links. All unused pigtails (including spares) shall be terminated with the connector to a bulkhead connector sleeve, protected by a reusable cap on the opposite sleeve port, to prevent the intrusion of foreign material or dust. All necessary connectorized pigtails shall be provided in the lengths required.

11.06.04 Fiber Optic Tool Kit

Fiber Optic Splicer, Terminator And Tool Kit Box

Bidder shall provide new unused tools comprise of Splicer and Fusion Jointer and tool kit comprise of cutter, stripper, polishing tool, handheld microscope, heat shrinkable sleeve, scissor, knife etc. as required for maintenance and commissioning.

11.07.00 Tests

Following minimum test as per any approved standards shall be carried out on the cables

a. Attenuation And Dispersion Characteristics Tests
b. Proof Tests
c. Macro-Bend Resistance Test
d. Mechanical Tests
e. Low And High Temperature Cable Bend Test
f. Impact Resistance Test
g. Compressive Strength Test
h. Tensile Strength Test
i. Cable Twist Test
j. Cable Cyclic Flexing Test
k. Environmental Characteristics Test
l. Temperature Cycling Test

m. Color Permanence Test Cable Aging Test

n. Water Penetration Test

o. Lightning Test

p. Routine Test / Sample Test

Site Test (Like Continuity & Attenuation)

ERECTION HARDWARE

m. Color Permanence Test Cable Aging Test

n. Water Penetration Test

o. Lightning Test

p. Routine Test / Sample Test

Site Test (Like Continuity & Attenuation)

12.00.00 ERECTION HARDWARE

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

12.01.00 ELECTRICAL ACCESSORIES

Electrical conduit and associated materials shall conform to the requirements of the articles which follow :

a) Rigid Steel Conduit

i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.

ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.

iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.

iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.

b) Flexible Conduit

i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.

ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.

c) Special Fittings

i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.

ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

12.01.01 Junction Box

01.	Type of Enclosure	:	Dust tight & weatherproof conforming to IP 65
02.	Material	:	2 mm sheet steel
03.	Type of Cover	:	Solid Hinged Door with steel handle and IP lock
04.	Paint	:	631 IS 5 Epoxy Powder Coated
05.	Mounting	:	Surface
06.	Cable Entry	:	3 mm (min) Gland plate
07.	Gasket	:	Neoprene
08.	Grounding	:	Brass earth lug with green screw head External-2 nos , Internal-1no.M6.
09.	Number of Drain Holes	:	Two at bottom capped.
10.	Identification	:	Label for JB and Tags for cable
11.	Accessories	: a)	Rail mounted cage clamp type screwless terminals with markers
		b)	Cable gland
		c)	Ferrules
		d)	Canopy at top

12.01.02 Cable Gland

01.	Type	:	Double compression
02.	Entry Thread	:	NPT
03.	Material	:	Brass
04.	Finish	:	Cadmium Plated.
05.	Protection	:	IP 65 or better

	06.	Accessories	:	Neoprene gasket, locknuts, reducers etc.

12.01.03 Cable Tray

	01.	Material	:	Mild steel
	02.	Thickness	:	not less than 2.0 mm
	03.	Finish	:	Hot dip galvanized
	04.	Perforation	:	As per MFR standard.
	05.	Cover	:	Suitable for tray
	06.	Height of the cable tray	:	100 mm for 450mm and above width. (width cannot be less than 100 mm)

12.02.00 PROCESS HOOK UP ACCESSORIES & SPECIFICATION

Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for Owner's approval.

12.02.01 Specification for Process Hook Up Materials

07.	BFP SUCTION / CONDENSATE SYSTEM / EXTRACTION TO LPH / EXTRACTION-4 TO BFP-T, DEAERATOR / AUXILIARY STEAM	G	ASTM-A106 GR. B	80 (½ INCH)	ASTM-A105	ASTM-A-182 GR. F6A	3000 LB	800
10.	Purge Air	–	ASTM-A106 Gr. C	80 (3/4 inch)	ASTM-A 105 Gr. F-22	SS or better	3000 lb	800
11.	DM Cooling Water	–	ASTM A312 TP 316	40 (1/2 inch)	ASTM A182 F316	SS or better	3000 lb	800
12.	CW & ACW	–	ASTM-A106 Gr. C	80 (½ inch)	ASTM-A 105	SS or better	3000 lb	800

NOTE :

(1) RATING OF PIPING / FITTINGS / VALVES ETC. IS SUBJECTED TO THE DESIGN PRESSURE & TEMPERATURE DURING THE DETAILED ENGINEERING.

(2) IN CASE TEMPERATURE IS MORE THAN 540 DEG. C, THE MATERIAL SHALL BE P-91 ONLY.

12.02.02 Seamless Stainless Steel Pipe

01.	Reference	:	ASTM A-312 TP 316
02.	Material Grade	:	TP 316
03.	Type	:	Seamless /Plain end
04.	Size	:	½" NB
05.	Schedule	:	40
06.	Standard Length	:	5 meter

12.02.03 Stainless Steel Pipe Fittings

01.	Reference	:	ASTM A-182 F 316 / ANSI B16.11
02.	Type	:	Forged
03.	Rating	:	3000 lbs / 6000 lbs / 9000 lbs
04.	Size	:	½" NB
05.	End connection	:	Generally socket weld
06.	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

12.02.04 Seamless Stainless Steel Tube

01.	Reference	:	ASTM A-213 TP 316
02.	Material Grade	:	TP 316
03.	Size	:	½" OD X 2.1 MM Thick
04.	Type	:	Cold drawn annealed, pickled, passivated, de-scaled, ,hydraulically cleaned seamless tube.
05.	Properties	:	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
06.	Test Pressure	:	400 Kg/Sq. cm (minimum)
07.	Tolerance	:	± 0.13 mm for outside diameter ± 15 % for wall thickness

	08.	Standard Length	:	5 meter
	09.	Test	:	Flare, Hardness, Ball and Bubble Test

12.02.05 Stainless Steel Tube Fittings

	01.	Reference	:	ASTM-A-182
	02.	Type	:	Double ferrule double compression
	03.	Material	:	316 Stainless steel forged
	04.	Ferrule	:	316 Stainless Steel
	05.	Type of Fittings	:	Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.
	06.	Size	:	To suit SS tubing and NPT end connection

12.02.06 C.S. Pipe

	01.	Reference	:	ASTM-A 106 Gr. C
	02.	Material	:	Cold drawn seamless black C.S.
	03.	Type	:	Seamless / Plain ends
	04.	Size	:	½" NB
	05.	Schedule	:	80, 160, XXS as required
	06.	Standard Length	:	5 meter

12.02.07 C.S. Pipe Fittings

	01.	Reference	:	ASTM-A 105 / ANSI B16.11
	02.	Type	:	Forged
	03.	Rating	:	3000 lbs / 6000 lbs / 9000 lbs
	04.	Size	:	½" NB
	05.	End connection	:	Generally socket weld
	06.	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

12.02.08 A.S. Pipe

01.	Reference	:	ASTM-A 335 P22 AS PER ANSI B 36.10
02.	Material	:	Cold drawn seamless A.S.
03.	Type	:	Seamless / Plain ends
04.	Size	:	½" NB
05.	Schedule	:	XXS
06.	Standard Length	:	5 meter

12.02.09 A.S. Pipe Fittings

01.	Reference	:	ASTM-A 182 F22 AS PER ANSI B 16.11
02.	Type	:	Forged
03.	Rating	:	9000 lbs
04.	Size	:	½" NB
05.	End connection	:	Generally socket weld
06.	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

12.02.10 Carbon Steel Globe Valve

01.	Reference	:	ASTM A-105
02.	Type	:	Globe
03.	Construction	:	Forged Body Cadmium Plated
04.	End Connection	:	½" Socket Weld
05.	Rating	:	Cl. 800 / CL. 2500
06.	Material	:	Body - Carbon steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
07.	Packing	:	Teflon / Grafoil as required

	08.	Yoke	:	ASTM A105
	09.	Handwheel	:	Carbon steel
	10.	Design standard	:	As per ANSI B 16.34

12.02.11 Stainless Steel Globe Valve

	01.	Reference	:	ASTM A-182 F316
	02.	Type	:	Globe
	03.	Construction	:	Forged Body
	04.	End Connection	:	Socket Weld
	05.	Proof Pressure	:	400 Kg/Cm2
	06.	Material	:	Body - Stainless steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	07.	Packing	:	Teflon as required
	08.	Yoke	:	ASTM A182 F316
	09.	Handwheel	:	Carbon steel
	10.	Design standard	:	As per ANSI B 16.34

12.02.12 Alloy Steel Globe Valve

	01.	Reference	:	ASTM A-182 F22
	02.	Type	:	Globe
	03.	Construction	:	Forged Body
	04.	End Connection	:	½” Socket Weld
	05.	Rating	:	CL. 2500
	06.	Material	:	Body - Alloy steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited

	07.	Packing	:	Grafoil as required
	08.	Yoke	:	ASTM A182 F22
	09.	Handwheel	:	Carbon steel
	10.	Design standard	:	As per ANSI B 16.34

12.02.13 Condensate Pot

	01.	Reference	:	ASTM A182 F22 /ASTM A105
	02.	Material	:	Alloy steel / carbon steel as per application
	03.	Construction	:	Drilled from barstock
	04.	End connection	:	3 nos. ½" socket weld end
	05.	Accessories	:	Vent valves

12.02.14 Instrument Valve Manifold

	01.	Type	:	a) Two valve manifold b) Five valve manifold
	02	Mounting	:	Remote 2" Pipe Mounting
	03.	Construction	:	Single block (bar stock)
	04.	Material	:	Forged body and bonnet AISI 316 stainless steel
	05.	Ports	:	1/2 " NPT (F)
	06.	Rating	:	420 Kg/Sq. cm at ambient
	07.	Operating Temperature	:	(-) 30 to (+) 170 Deg C
	08.	Packing	:	PTFE Wafer
	09.	Seat & Stem	:	AISI 316 SS
	10.	Plug	:	AISI 316 SS free to turn on stem / 17-4 PH
	11.	Handle Bar	:	AISI 316 SS
	12.	Connection	:	Straight
	13.	Accessories	:	i) Plugs for all ports

ii) Mounting Bracket , bolts , nuts

12.03.00 PNEUMATIC HOOK UP ACCESSORIES

12.03.01 Air Header

Technical Particulars :

			For Panel	For Field
01.	Material of Construction	:	Stainless steel	Stainless steel
02.	Inlet Connection	:	2" NPT (M)	1" NPT (M)
03.	Header Take-off	:	Stainless steel	Stainless steel
04.	Take off connection	:	1 / 2” NPT (M)	1/ 2” NPT (M)
05.	Take-off Valves	:	stainless steel	stainless steel
06.	Tube Take-off	:	Tube adapter on valve	Tube adapter on valve
07.	Drain	:	SS drain valve at lowest point	SS drain valves at lowest point

12.03.02 Seamless Stainless Steel Tube

01.	Reference	:	ASTM A-269 TP 31605
02.	Material Grade	:	TP 316
03.	Size	:	¼” OD X 0.049” wall thickness
04.	Type	:	Cold drawn annealed, pickled, passivated, de-scaled, ,hydraulically cleaned seamless tube.
05.	Properties	:	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
06.	Test Pressure	:	400 Kg/Sq. cm
07.	Tolerance	:	± 0.13 mm for outside diameter ± 15 % for wall thickness
08.	Standard Length	:	5 meter

09. Test : Flare, Hardness, Ball and Bubble Test

QUALITY ASSURANCE

2.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured and tested at all the stages, as well as Services provided for erection, commissioning and testing shall be as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme and reviewed by by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Owner's representative for review. Schedule of finalisation of such quality plans will be finalised before award.

2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.

2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.

2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Consultant's approval without which manufacture shall not proceed. In these approved quality plans, Owner/Authorised representative/Consultant shall identify Customer Hold Points (CHP), test/checks which shall be carried out in presence of the Owner/Consultant/Owners Owner's Engineer or his Authorised Representative and beyond which the work will not proceed without consent of Owner/Authorised representative/Consultant in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised Representative/Consultant for acceptance and dispositioning.

2.05.00 The Bidder shall provide adequate notice to the Owner for inspection before the material is dispatched as per the provisions of the Contract. No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of

all previous tests/inspections by Owner's Owner's Engineer/Authorised representative, and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC).

2.06.00 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.

2.07.00 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.

2.08.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.

2.09.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Bidder's/Sub-Vendor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.

For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.

Under no circumstances any repair or welding of castings be carried out without the consent of the Owner. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Owner.

All pressure parts shall be subjected to hydraulic testing as per the requirements of IBR. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than thirty (30) minutes.

2.10.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT shall be properly recorded and submitted for acceptance.

All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid

penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed. Statutory payments in respect of IBR approvals including inspection shall be made by Bidder. Bidder's scope and responsibility shall also include preparation and submission of all necessary documents in the specific formats and manner stipulated by the statutory bodies, coordination and follow up for above approvals.

2.11.00 All the Sub-Vendors proposed by the Bidder for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Bidder and finalised with the Owner shall be subject to Owner's review. Quality Plans of the successful Sub-Vendors shall be discussed, finalised and accepted by the Owner/Authorised representative and form part of the Purchase Order between the Bidder and the Sub-Vendor.

2.12.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Bidder and finalised with the Owner shall be furnished to the Owner for comments and subsequent acceptance before orders are placed.

Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their Sub-Vendor's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.

Quality audit/acceptance of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Bidder in earning satisfactory performance of equipment as per specification.

2.13.00 Quality requirements for main equipment shall equally apply for spares and replacement items.

2.14.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the acceptance of the Owner.

2.15.00 For quality assurance of all civil works refer to the specifications for civil works.

3.00.00 QUALITY ASSURANCE DOCUMENTS

3.01.00 The Bidder shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after despatch of the equipment:

a) Material mill test reports on components as specified by the specification.

b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.

c) Non-destructive examination results /reports including radiography interpretation reports.

d) Factory tests results for testing required as per applicable codes and standards referred in the specification.

e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.

f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

g) Stress relief time temperature charts.

h) Inspection reports duly signed by QA personnel of the Owner and Bidder for the agreed inspection hold points. During the course of inspection, the following will also be recorded :

i) When some important repair work is involved to make the job acceptable.

ii) The repair work remains part of the accepted product quality.

i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

4.01.00 The Successful Bidder shall give the Owner’s Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Successful Bidder's account except for the expenses of the Inspector. The Owner’s Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Successful Bidder may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.

4.02.00 The Owner’s Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Successful Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Successful Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Owner’s Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

4.03.00 When the factory tests have been completed at the Bidder's or sub-Vendor's works, the Owner/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Owner/ Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Owner/Inspector. Failure of the Owner/Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

4.04.00 The Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

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QUALITY PLAN
FOR
ULTRASONIC FLOWMETER

QUALITY PLAN NO.:	**PE-QP-445-145-I011**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 05.02.21
SHEET	2 OF 3

Sl. No.	Component / operation	Characteristics Checked	Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1 1.0	Electronic Housing	Chemical Property	Major	Visual	100%	Approved drg/ Data sheet	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	2	---	1	
2.0	Standard Certificates	Certificate of Compliance, Warranty Certificate	Major	Visual	As applicable	Technical documents/ Approved documents	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	2	---	2,1	
3.0	Visual Check	Mechanical	Major	Visual	100%	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	2	1	1	
1 4.0	Complete assembly	Overall dimension and end connection	Major	Measurement	100%	Approved drg/ Data sheet	Technical catalogue/ Approved documents	Inspection Report	2	2	1	
		Marking-Tag No, direction of flow	Minor	Visual	100%	Approved drg/ Data sheet	Technical catalogue/ Approved documents	Inspection Report	2	2	1	
5.0	Function test & power ON	Electrical	Major	Visual	100%	Functional test report for meter & transducer	Approved documents	Technical catalogue/ Approved documents	2	---	1	
6.0	HART Communication	Electrical	Major	---	100%	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	--	---	1	

LEGEND:

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

1 - BHEL
2 - Vendor/Sub-vendor

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QUALITY PLAN
FOR
ULTRASONIC FLOWMETER

QUALITY PLAN NO.:	**PE-QP-445-145-I011**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 05.02.21
SHEET	3 OF 3

Sl. No.	Component / operation	Characteristics Checked	Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1 7.0	PACKING & DISPATCH	Soundness of Packing against transit damage	Major	Visual	100%	Manufacturer Standard	Technical catalogue/ Manufacturer Standard		2	1	---	

NOTE:

1 1. Protection class shall be IP-65 or better or as per approved datasheet.
2. Type test certificates/Type test reports for “Protection class” shall be verified by BHEL.
3. CALIBRATION Test to be carried out at NABL or BHEL approved laboratory.
4. All test reports / test certificates shall be submitted to WBPDCL for information.

LEGEND:

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QUALITY PLAN
FOR
FLOW ORIFICE PLATE ASSEMBLY

QUALITY PLAN NO.:	**PE-QP-445-145-I005**
VOLUME	IIB
SECTION	D
REV. NO.	00 DATE: 24.05.19
SHEET	5 OF 6

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
1.0	**MATERIAL**											
1.1	Orifice Plate	1. Physical, Chemical properties	MA	Physical, Chemical Tests	One / Plate OR One/ Heat	AP / DS / SP	AP / DS / SP	Lab Report	3/2	---	2,1	IBR certification (if applicable) to be verified by BHEL
		2. Dimensions	MA	Measurement	100%	AP	AP	IR	3/2	___	1	
1.2	**Flanges** A. Forgings	Chemical,Mech Properties, UT & Heat Treatment	MA	Chem & Mech UT test	Sample	Material Spec as per ASTM A 388 for UT	ANSI B 16.34	MTC,UT cert,HT cert	3/2	---	1	
	B. Machining	Dimensions	MA	Measurement	100 %	AP / DS	AP / DS	IR	3/2	----	1	
2.0	**IN PROCESS** Machine	1. Dimension	MA	Measurement	100%	AP	AP	IR	3/2	2	2	
		2. Surface finish	MA	Visual	100%	----------	Mirror Finish	-------	3/2	2	---	
		3. Surface flaw on machined surface	MA	Penetrant test	100%	ASTM 165 / IS:3658	No surface flaw	IR / TC	3/2	2	1	
3.0	**ASSEMBLY and FINAL INSPECTION**	1. Overall dimensions	MA	Measurement	100%	AP	AP	IR	3/2	2,1	----	
		2. Marking, Tag no. Direction of flow	MA	Visual	100%	AP / DS	AP / DS	IR	3/2	2	1	
		3. Calibration	MA	Performance Test	One per type	----------	SP	TC	3/2	----	1	
		4. Painting	MA	Visual	100%	SP / MS	SP / MS	IR / MR	3/2	----	1	
		5. Root valve BOQ	MA	Measurement	100%	AP / DS	AP / DS	IR	2	----	1	

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

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QUALITY PLAN
FOR
FLOW ORIFICE PLATE ASSEMBLY

QUALITY PLAN NO.:	**PE-QP-445-145-I005**		
VOLUME	IIB		
SECTION	D		
REV. NO.	00	DATE:	24.05.19
SHEET	6	OF	6

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
4.0	**PACKING**	Soundness of Packing against transit damage	MA	Visual	100%	SP / MS	SP / MS	----	3/2	----	----	Refer Note 4

NOTE:

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

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DS – Data Sheet; SP – Tech. Spec.
MR- Manufacturer records; MS- Manufacturer standards
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QUALITY PLAN
FOR
CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.:	**PE-QP-445-145-I 006**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE:
SHEET	1 OF 6

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
1.0	**MATERIAL**											
1.1	Body & Bonnet casting / forgings, plug, valve stem, seat ring/cage	1. Physical, Chemical properties	MA	Physical, Chemical tests	One/ Heat(HT Batch)	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	3	---	2,1	TC for body/bonnet from foundry only
		2. Heat Treatment	MA	Review of H.T. Chart	Each H.T.	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	3/2	2	1	1.IBR Certification (if applicable) to be verified by BHEL. 2.Applicable for body /bonnet only
		3. Internal quality of castings	MA	RT for Body & UT for Bonnet	100%	ASME B 16.34	ASME B 16.34	Test Report / FILM	3/2	2	1	Applicable for Body and Bonnet for rating ANSI 900 and above.
		4. Surface Quality	MA	1. Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	---	2	
				2. MT/PT	100%	ASME B 16.34	ASME B 16.34	Test Certificate	3	2	1	After Machining on machined surface only
		5. Pressure test for shell	MA	Hyd. Test	100%	ISA-S-75.19/ ASME B 16.34	ISA-S-75.19/ ASME B 16.34	Test Certificate	2	2	1	For Body & Bonnet after machining

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor; 4 - WBPDCL

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QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.:	**PE-QP-445-145-I 006**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE:
SHEET	2 OF 6

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
1.2	Diaphragm	1. Surface Quality	MA	Visual	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2	
		2. Hardness	MA	Measurement	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2	
		3. Endurance / Life cycle	MA	Cyclic test 10,000 cycles	One / Type	10,000 cycles/ Mfr. standard.	No damage	Test Certificate	3/2	---	2,1	
1.3	Spring	1. Composition	MA	Chemical-Analysis	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
		2. Mech. Properties	MA	Mech. Test	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
		3. Performance	MA	1. Stiffness ratio	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
				2. Scragging	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
				3. Cyclic test (Endurance)	One / type	10,000 cycles	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				4. Dimension (Measurement)	One sample/ Lot	Mfr. standard	Mfr. standard	Record	3	---	2	
1.4	Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)]	1. Routine Test	MA	HV, IR, Continuity function	100%	Relevant Standards	Relevant Standards	Test Certificate	3	---	2	
		2. Degree of protection	MA	IP/NEMA Tests	One sample / type	Approved Data sheet	Approved Data sheet	Test Certificate	3	---	2,1	

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1 - BHEL 2 - Vendor 3 - Sub-vendor 4 - WBPDCL

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QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
1.5	Pressure Gauges (if provided externally)	1. Performance	MA	Review of calibration certificates	100%	Mfr. Standard	Mfr. Standard	Test Certificate	3	---	2	
		2. Marking	MA	Visual	100%	Mfr. standard	Mfr. standard	Records	3	---	2	
2.0	**IN PROCESS INSPECTION**											
2.1	After machining, i. Body ii. Bonnet iii. Plug iv. Valve Stem v. seat ring/cage	1. Surface flaws	MA	Visual & MT/PT	100% (on accessible surfaces)	ASME B 16.34	ASME B 16.34	Test Records	2	---	1	Butt weld ends shall be included.
		2. Dimensional checks	MA	Measurement	100%	Mfr. Standard	Mfr. Standard	Records	2	---	1	
		3. Hard facing (wherever applicable)	MA	Hardness Measurement	One sample/Lot	Mfr. Standard	Mfr. Standard	Records	2	---	1	
3.0	**TESTS ON COMPLETED VALVE**											
3.1	Actuator Chamber	Leakage & Strength	MA	Pneumatic test	100%	Mfr. Standard	No Leakage	Test Certificate	2	1	1,4	Refer Note-4
3.2	Body	Leakage and Pressure test (Body Mount Leakage)	MA	Hydro test	100%	ISA - S-75.19/ ASME B16.34	No Leakage	Test Certificate	2	1	1,4	Refer Note-4
3.3	Seat leakage test for completed valve	Seat Leakage	MA	Pneumatic Test	100%	FCI-70.2	FCI-70.2	Test Certificate	2	1	1,4	Refer Note-4
4.0	**OPERATION TEST ON COMPLETED VALVE (Final inspection)**	1. Valve Travel	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		2. Opening/Closing time	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		3. Linearity/cam characteristic	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
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QUALITY PLAN
FOR
CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.:	**PE-QP-445-145-I 006**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE:
SHEET	4 OF 6

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		4. Repeatability	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		5. Hysteresis	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		6. Sensitivity	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		7. Accuracy (Overall)	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		8. Control Valve characteristics / CV Test	MA	♦Measurement (Press. vs. discharge and discharge vs. opening 0-100% in steps of 10%)	One per type	Mfr. Procedure	Approved drg. / data sheet	Test Certificate	2	--	1,4	♦Size = Body & port size Or Body size & CV for non std port. Refer Note 1.
		9. Operation of limit switch & solenoids and other accessories	MA	Function	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	On assembled valve Refer Note-4
		10. Overall dimensions	MI	Visual and dimensional	100%	Approved drg. / data sheet	Approved drg. / data sheet	Records	2	1	1,4	Refer Note-4
		11. Pre defined valve position in case of air failure	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	1	1,4	1
		12. Cleanliness, painting, stamping (for direction of flow), Tag No.	MA	Visual and dimensional, paint thickness	100%	Mfr. Procedure	Approved drg. / data sheet	Test Certificate	2	1	1,4	
		13. Surface Quality	MA	Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	--	2,1, 4	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor; 4 - WBPDCL

PEM :: C&I

QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.:	**PE-QP-445-145-I 006**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE:
SHEET	5 OF 6

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
5.0	**AUXILIARY ITEMS (Performance test of auxiliary items shall be performed on the completely assembled valve)**											
5.1	Positioner	Overall leakage after assembly including Nozzles leakage	MA	Leak Test (in the steady state input signal)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	Certificate of Conformance (C.O.C)
5.2	Air filter regulator	1. Normal air consumption	MA	Measurement	Each type	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)
		2. Overall leakage	MA	Visual (soap solution)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)
5.3	Air lock relay	Performance Test	MA	Leakage test	100%	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)
5.4	Electronic position transmitter(not applicable if provided integral to smart positioner)	1. Accuracy	MA	Operation	100%	Approved data sheet /	Approved data sheet /	Test Certificate	2	1	---	(C.O.C)
5.5	Current to Pneumatic converter(not applicable for smart positioner)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	---	(C.O.C)
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	---	(C.O.C)
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
		4. Hysterisis	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test
PT – Dye penetrant Test; MT- Magnetic Test
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
5.6	Smart Positioner (As Applicable)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	---	(C.O.C)
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	---	(C.O.C)
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
		4. Hysterisis	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
		5. Calibration with Hand Held Communicator	MA	Measurement	Each type	Mfr. Standard	Mfr. Standard	Test Certificate	2	---	---	(C.O.C)
6.0	**PAINTING**	Soundness of Painting	MA	Visual and Measurement	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-2
7.0	**PACKING**	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-3

NOTES:

1. In case valid CV test certificate for a similar control valve(same size, same CV, same trim characteristics) is not submitted to BHEL by the vendor, CV test shall be conducted at FCRI/Any govt. approved laboratory/ BHEL approved Laboratory.
2. In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
3. Sea worthy packing shall be provided, if called for in the Data sheets.
4. The quantum of check shall be 100% for manufacturer and 10% for BHEL/BHEL nominated inspection agency.
5. IBR certificates in Form III-C shall be submitted if called for in the specification/datasheet.
6. Copies of all TC's(Test Certificates) for materials duly correlated with Heat Nos., TC's for electrical items and mechanical tests(Leak/Operation), C.O.C's(Certificates of Conformance) shall be submitted to BHEL for verification and acceptance.

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test
PT – Dye penetrant Test; MT- Magnetic Test
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STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANALYTICAL INSTRUMENTS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	VISUAL						
	MAKE, MODEL No.						
	POWER SUPPLY						
	TYPE						
2	DIMENSIONS CHECK			P	V	V	
3	FUNCTIONAL CHECK			P	V	V	
4	LEAKAGE TEST			P	V	V	
5	HV / IR TEST			P	V	V	
6	LINEARITY			P	V	V	
7	RESPONSE TIME			P	V	V	
8	ENCLOSURE CLASS			P	V	V	
9	ACCESSORIES, AS APPLICABLE			P	V	V	
10	ACCURACY / CALIBRATION			P	V	V	
11	ALARM CONTACT TEST			P	V	V	
12	ANALOG OUTPUT CHECK			P	V	V	
13	BURN-IN TEST OF ELECTRONIC PARTS	1/LOT		P	V	V	
14	IN-BUILT INDICATOR, ZERO, SPAN, RANGE SCALE SELECTION ETC	SEE NOTE-1 BELOW		P	V	V	

Legend :

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

Note :

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

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

CHECK LIST FOR TRANSMITTER

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

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Note :

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

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

CHECK LIST FOR TEMPERATURE ELEMENT

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MODEL No./TAG No.						
	PROCESS CONNECTION						
2	STABILITY			P	W	V	
3	INSULATION RESISTANCE			P	W	V	
4	ENCLOSURE CLASS			P	W	V	
5	RESPONSE TIME			P	W	V	
7	ACCURACY			P	W	V	
8	HYDROSTATIC TEST			P	W	V	
9	ELECTRICAL CHARACTERISTIC OF SENSOR (CONTINUTY OF T/C WIRES & INSULATION RESISTANCE OF RTD LEADS w.r.t. BODY			P	W	V	
10	TEMP CURVES / CHARTS			P	V	V	
11	AMBIENT TEMP. EFFECT CHECK			P	W	V	
12	HV TEST			P	W	V	

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Note :

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

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

CHECK LIST FOR SOLENOID VALVES

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MAKE						
	MODEL No.						
2	MATERIAL (BODY. PLUNGER/TRIM)			P	W	V	
3	PORT SIZE			P	W	V	
4	CABLE CONNECTION SIZE			P	W	V	
5	ENCLOSURE CLASS			P	W	V	TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR
6	No. OF COILS & INSULATION CLASS			P	W	V	TEST CERTIFICATE TO BE FURNISHED FOR INSULATION CLASS BY VENDOR
7	POWER SUPPLY CHECK			P	W	V	
8	IR / HV TEST			P	W	V	
9	FUCTIONAL TEST			P	W	V	

Legend :

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Note :

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

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

CHECK LIST FOR TEMPERATURE GAUGE

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

Legend :

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Note :

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

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

CHECK LIST FOR PRESSURE & DP GAUGE

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

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Note :

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

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

CHECK LIST FOR LEVEL GAUGE

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

Legend :

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Note :

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

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

CHECK LIST FOR SIGHT FLOW INDICATOR

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	MODEL						
	TAG No.						
	VISUAL						
2	DIMENSIONS,			P	W	V	
3	PROCESS CONNECTION			P	W	V	
4	RANGE / SCALE			P	W	V	
5	ACCURACY			P	W	V	
6	MATERIAL TC FOR METERING TUBE, ORIFICE PLATE, FLANGES AND FASTNER			P	V	V	
7	CALIBRATION REPORT	ONE / SIZE		P	V	V	
8	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	
9	TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	

Legend :

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Note :

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

TYPE TEST REQUIREMENT

13.00.00 TYPE TEST REQUIREMENTS

13.01.00 General Requirements

13.01.01 Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'Type Test Requirement for C&I Systems' at the end of this sub-section. For the balance equipment instrument, type tests may be conducted as per manufacturers standard or if required by relevant standard.

13.01.02 Out of the tests listed, Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Owner or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.

13.01.03 For the rest, submission of type test results and certificate shall be acceptable provided:

a) The same has been carried out by Bidder/ sub-vendor on exactly the same model / rating of equipment.

b) There has been no change in the components from the offered equipment & tested equipment.

c) The test has been carried out as per the latest standards along with amendments as on the date of bid opening.

13.01.04 In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by Bidder within the quoted price and no extra cost will be payable by Owner on this account

13.01.05 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by Bidder or his authorized representative and the balance have to be approved by Owner.

13.01.06 The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.

13.01.07 For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Owner. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.

13.01.08 Bidder shall indicate in his bid, the cost of the type test for each items only for which type tests are to be conducted specifically for this project.

13.02.00 Special Requirement for Solid State Equipments/ Systems

The minimum type tests reports, over and above the requirements of above clause which are to be submitted for each of the major C&I systems like SG-C&I system, TG- C&I system, Station - C&I system, Flame monitoring system, Coal feeders control and instrumentation system, Boiler flame analysis system, Turbine supervisory system, BFP Turbine supervisory instruments, Analyzer instruments, Vibration monitoring systems, etc. shall be as indicated below:

13.02.01 Surge Protections for Solid State Equipments/ Systems

All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Hence, all front end cards which receive external signals like analog input & output modules, binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of IEC-255-4 which is equivalent to ANSI 37.90a/ IEEE-472 may also be adopted for SWC test.

13.02.02 Dry heat test as per IEC-68-2-2.

13.02.03 Damp heat test as per IEC-68-3.

13.02.04 Vibration test as per IEC-68-2-6.

13.02.05 Electrostatic discharge tests as per IEC 801-2 or equivalent.

13.02.06 Radio frequency immunity test as per IEC 801-6 or equivalent.

13.02.07 Electromagnetic immunity as per IEC 801-3 or equivalent.

Test listed at clause no. 13.02.05, 13.02.06 & 13.02.07 above are applicable for front end cards only as defined under clause no. 13.02.01 above.

13.03.00 Type Test Requirement for C&I Systems

SL. NO.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
01.	THERMOCOUPLES	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
02.	RTD	AS PER STANDARD	IEC-751	NO	NO	
03.	C.J.C. BOX	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
		AMBIENT TEMP. EFFECT	APPROVED PROCEDURE	NO	YES	
04.	ELECTRONIC TRANSMITTER	AS PER STANDARD	BS-6447 / IEC-770	NO	YES	
05.	E/P CONVERTER	AS PER STANDARD	MFR. STANDARD	NO	YES	
06.	DUST EMISSION MONITOR	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
07.	INSTRUMENTATION CABLES TWISTED & SHIELDED			YES	YES	
	A) CONDUCTOR	● RESISTANCE TEST	VDE-0815			
		● DIAMETER TEST	IS-10810			
		● TIN COATING TEST (DRAIN WIRE)				
	B) INSULATION	● LOSS OF MASS	VDE-0472			
		● AGING IN AIR OVENS	VDE 0472 **			** AS PER VDE 0207 FOR TEFLON INSULATED CABLES
		● TENSILE STRENGTH AND ELONGATION	VDE 0472 **			
		● HEAT SHOCK	VDE 0472 **			
		● HOT DEFORMATION	VDE 0472			
		● SHRINKAGE	VDE 0472			
		● BLEEDING & BLOOMING	IS-5831			
	C) INNER SHEATH	● LOSS OF MASS	VDE-0472			
		● HEAT SHOCK	VDE 0472 **			
		● COLD BEND / COLD IMPACT TEST	IS-5831			
		● HOT DEFORMATION	VDE 0472			

SL. NO.	ITEM		TEST REQUIREMENT		STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
			●	SHRINKAGE	VDE 0472			
	D)	OUTER SHEATH	●	LOSS OF MASS	VDE-0472			
			●	AGING IN AIR OVENS	VDE 0472 **			
			●	TENSILE STRENGTH AND ELONGATION TEST BEFORE AND AFTER AGEING	VDE 0472 **			
			●	HEAT SHOCK	VDE 0472 **			
			●	HOT DEFORMATION	VDE 0472			
			●	SHRINKAGE	VDE 0472			
			●	BLEEDING & BLOOMING	IS-5831			
			●	COLOUR FASTNESS TO WATER	IS-5831			
			●	COLD BEND / COLD IMPACT TEST	IS-5831			
			●	OXYGEN INDEX TEST	ASTMD-2863			
			●	SMOKE DENSITY TEST	ASTMD-2843			
			●	ACID GAS GENERATION TEST	IEC-754-I			
	E)	FIILERS	●	OXYGEN INDEX TEST	ASTMD-2863			
			●	SMOKE DENSITY TEST	ASTMD-2843			
			●	ACID GAS GENERATION TEST	IEC-754-I			
	F)	AL-MYLAR SHIELD	●	CONTINUITY TEST				
			●	SHIELD THICKNESS				
			●	OVERLAP TEST				
			●	NOISE INTERFERENCE	IEEE TRANSACTIONS			
	G)	OVERALL CABLE	●	FLAMMABILITY	IEEE 383			
			●	NOISE INTERFERENCE				

SL. NO.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
		• DIMENSIONAL CHECKS	IS 10810			
		• CROSS TALK				
		• MUTUAL CAPACITANCE	VDE 0472			
		• HV TEST	VDE 0472			
		• DRAIN WIRE CONTINUITY				
08.	PRESSURE GAUGE	• DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
		• TEMPERATURE INTERFERENCE TEST	IS-3624	NO	NO	
09.	TEMPERATURE GAUGE	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
10.	PRESSURE & DIFFERENTIAL PRESSURE SWITCH	• DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
		• AS PER STANDARD	BS 6134	NO	NO	
11.	LEVEL SWITCH	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
12.	CONDUCTIVITY LEVEL SWITCH	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
13.	CONTROL VALVES	CV TEST	ISA 75.02	YES	NO	
14.	FLOW NOZZLES & ORIFICE PLATE	CALIBRATION	ASME PTC, BS-1042	YES	NO	
15.	PLCs	ALL TESTS AS PER IEC-1131	IEC-1131			
16.	DCS					
	a) I/O MODULES	CMRR & NMRR VERIFICATION	Mfr. standard	NO	YES	
	b) OTHER MODULES	CMRR & NMRR VERIFICATION	Mfr. standard	NO	YES	
	c) CLCS SYSTEMS	MODEL TEST	Approved Procedure	YES	YES	
17.	LIE / LIR / JUNCTION BOX	DEGREE OF PROTECTION TEST	IS-2147	YES	YES	
18.	FLUE GAS O_2 ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
19.	FLUE GAS CO_2 ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	

SL. NO.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
20.	FLUE GAS SO_2 ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
21.	FLUE GAS NO_X ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	

APPLICABLE CODES AND STANDARDS

5.00.00 CODES AND STANDARDS

The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE , IS etc. Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall be applicable.

1) Temperature Measurement

a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).

b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.

c) Temperature Measurement by electrical resistance thermometers - IS: 2806

d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.

2) Pressure Measurement

a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).

b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.

3) Flow Measurement

a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II

b) Measurements of fluid flow in closed conduit - BS 1042.

4) Electronic Measuring Instruments and Control Hardware

a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319

b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.

c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.

d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).

e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4.

f) Printed circuit boards - IPC TM-650, IEC 326C.

g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.

h) Edge socket connectors - IEC 130-11.

i) Requirements and methods of testing of wire wrap terminations--DIN 41611 Part-2.

j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)

k) Direct Acting Electrical Indicating Instruments - IS - 1248 - 1968

5) Instrument Switches and Contacts

a) Contact Rating - AC services NEMA ICS Part-2 125, A-600

b) Contact Rating - DC services NEMA ICS Part-2 125, N-600

6) Enclosures

a) Enclosures for Industrial Controls and Systems–NEMA ICS-6-110.15 through 110.22

b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972) / IEC 60947 / IEC 60529

c) Protection Class for Enclosures , Cabinets Control Panels and Desks - IS 2147 1962

7) Apparatus, Enclosures and Installation Practices in Hazardous Area

a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978./ NFPA Article 500 , Vol.70-1984

b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.

c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.

d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1982.

8) Sampling System

a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.

b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.

c) Steam and water sampling ,conditioning and analysis in the power cycle - ASME PTC - 19.11

d) Standard methods of sampling system - ASTM D 1066-69

9) Annunciators

a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.

b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.

10) Interlocks, Protections

a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.

b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.

c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.

d) Turbine water damage prevention - ASME-TDP-1-1980.

e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

f) Installation and operation of Pulverized fuel system - ANSI / NFPA 8503

g) Functional diagramming of Instrument and control systems - SAMA PMS 22.1

h) Digital interface for programmable instrumentation - ANSI / IEEE 488

11) Control Valves

a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.

b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.

c) Control Valve seat leakage – ANSI / FCI 70.2

d) Face to face dimensions of Control Valves - ANSI B16.10

e) Control Valve Capacity Test Procedure – ISA – S75.02

12) Process connection Piping and Tubing

a) Seamless Carbon Steel Pipe - ASTM-A-106.

b) Forged carbon steel fittings - ASTM-A-105.

c) Dimensions of fittings - ANSI-B16.11.

d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.

e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.

f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316

g) Seamless Alloy Steel Pipe ASTM A 335 P22

h) Seamless Stainless Steel Pipe ASTM A-312 TP 316

i) Forged and Rolled alloy steel pipe flanges , forged fittings , valves and parts ASTM A - 182

j) Pipe fittings of wrought carbon steel and ally steel - ASTM A - 234

k) Composition bronze metal castings ASTM B - 62

l) Seamless copper tube , bright annealed ASTM B- 168

m) Valves flanged and butt welding ends ANSI B 16.34

13) Cables

a) Thermocouple extension wires / cables - ANSI MC96.1.

b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402

c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422.

d) Requirements of vertical tray flame test - IEEE 383

e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.

14) Electronic Cards, Subassemblies and Components

a) Unpackaged

i)	Vibration	:	IEC-68.2.6
ii)	Shock	:	IEC-68.2.27
iii)	Drop & Topple	:	IEC-68.2.31

b) Packaged

Vibration, Drop & Static Compression - NSTA.

c) Electromagnetic Compatibility

i)	Electrical Fast Transient	:	IEC-801.4
ii)	Surge Withstand	:	IEC-255.4
iii)	Radiated Electromagnetic Field	:	IEC-801.3
iv)	Electrostatic Discharge	:	IEC-801.2
v)	Electromagnetic Emissions	:	VDE 0871, Class-B

15) Cable Trays, Conduits

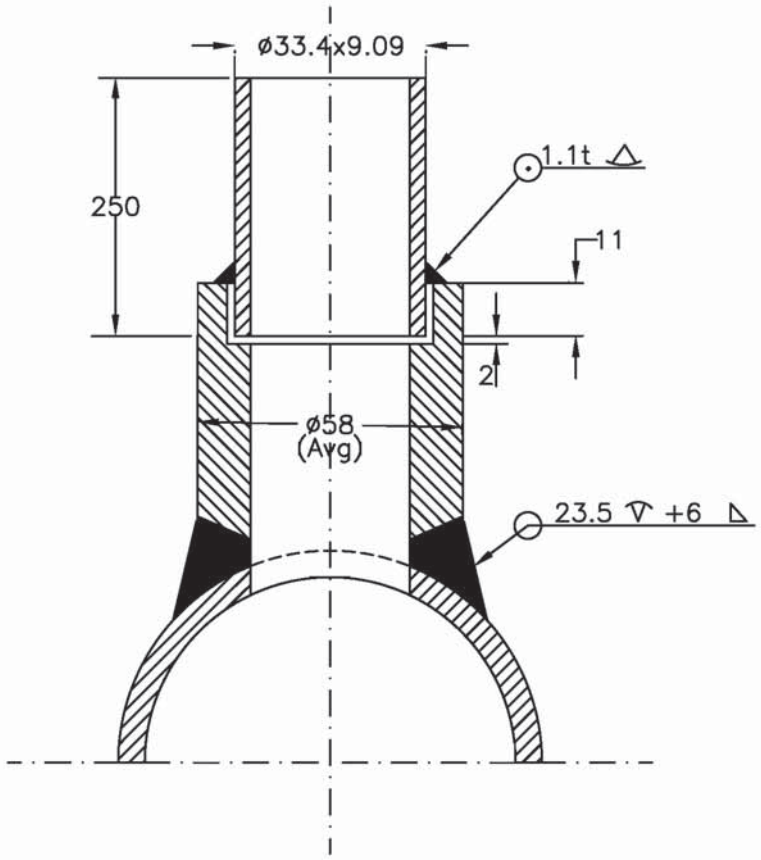
a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.

b) Galvanizing of carbon steel cable trays - ASTM A-386.

Codes and standards as described in different sub-sections of this specification shall also be followed .

Items such as thermowells, control valves, flow elements and other in line devices in high and medium pressure steam, feed water and similar services, which fall under the purview of Indian Boiler Regulation Act shall be either certified by IBR or shall be certified by authorities acceptable to IBR. It shall be responsibility of Bidder to obtain the necessary approval of the concerned Authority / Chief Inspector of Boilers for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification.

INSTRUMENT STUB DETAILS



NOTE :

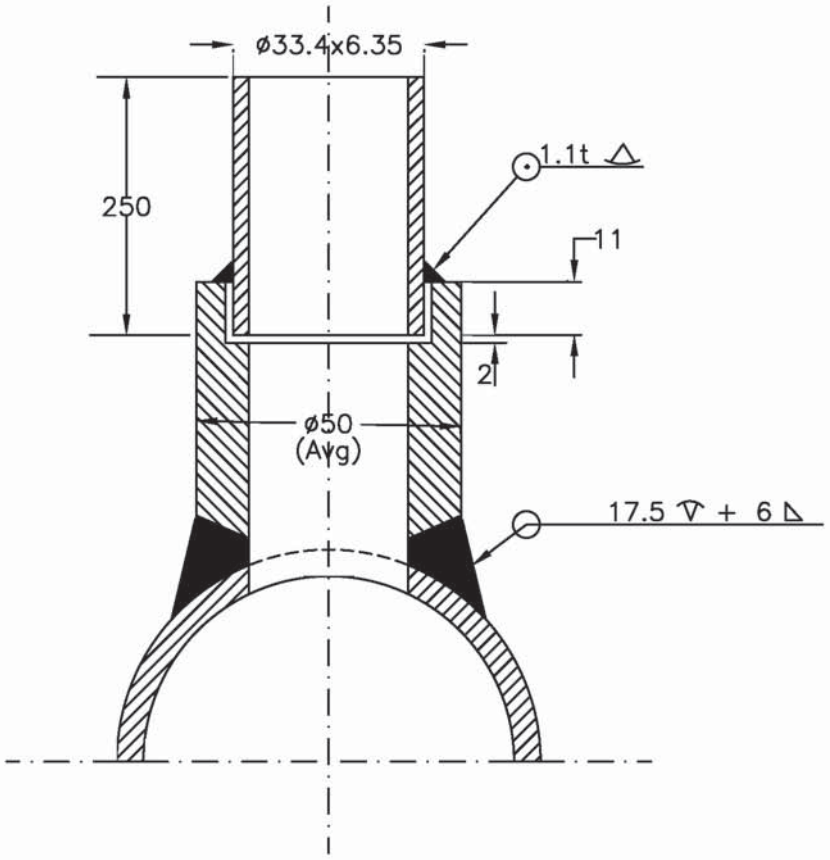
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHOULD BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO PROCESS DATA. 1

BHEL

1

TITLE :
INSTRUMENT STUB DETAILS
FOR PRESSURE MEASUREMENT
(TEMP > 500 DegC AND Nb25, CLASS 9000 #)
OR (PRESS > 455 Kg/Cm2 AND Nb25, CLASS 9000 #)

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 2 OF 8 SHS.



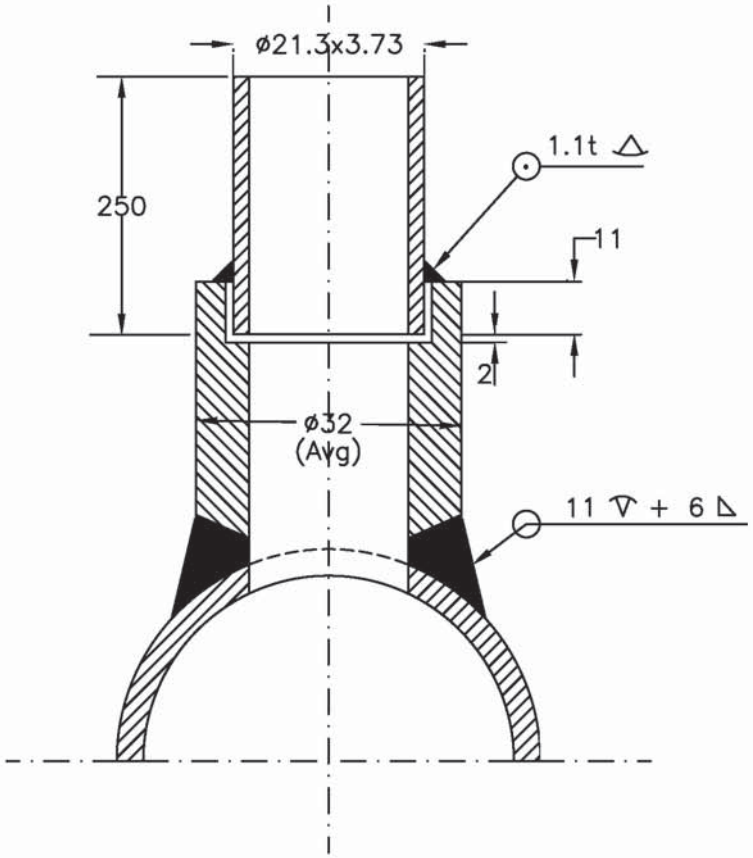
NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO PROCESS DATA. (1)

BHEL

TITLE :
INSTRUMENT STUB DETAILS
FOR PRESSURE MEASUREMENT
(60Kg/Cm2<PRESS≤455Kg/Cm2, TEMP≤425 DegC & Nb25, CLASS 6000#)
OR (PRESS≤455Kg/Cm2, 425DegC<TEMP≤500 DegC & Nb25, CLASS 6000#)

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 3 OF 8 SHS.



NOTE :

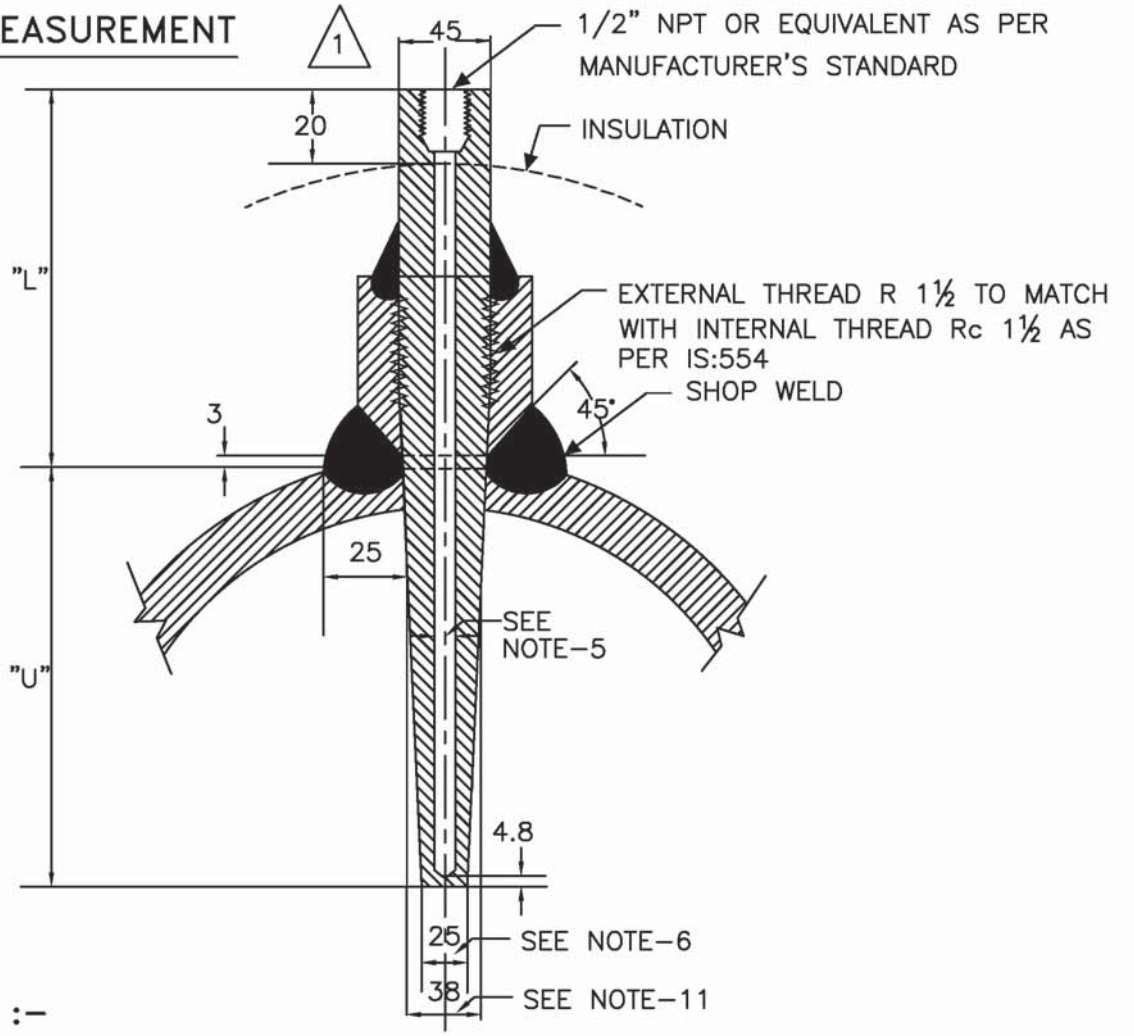
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO PROCESS DATA. 1

BHEL

TITLE :
INSTRUMENT STUB DETAILS
FOR PRESSURE MEASUREMENT
(PRESS < 60Kg/Cm2, TEMP < 425DegC & Nb15, CLASS 3000#)

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 4 OF 8 SHS.

TEMP. MEASUREMENT



NOTES :–

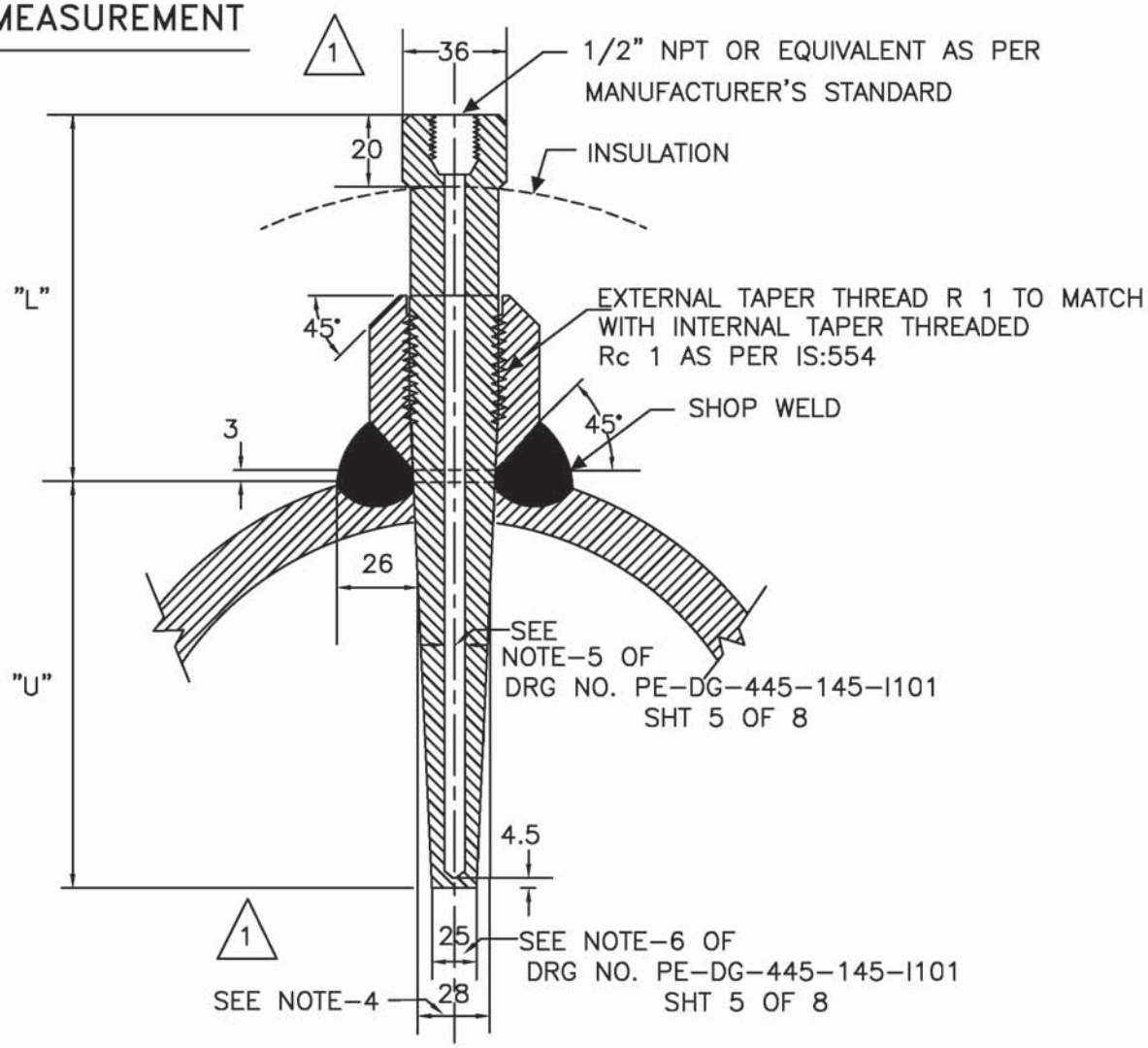
1. THIS TYPE OF TEMPERATURE BOSS SHALL BE USED FOR THE DESIGN PRESS EQUAL/ ABOVE 40 KG/CM2(g) AND FOR DESIGN TEMP EQUAL/ABOVE 400 DegC EVEN IF THE DESIGN PRESSURE IS LESS THAN 40 Kg/Cm2(g)
2. THE MATERIAL OF THE BOSS SHALL BE SIMILAR TO PIPING MATERIAL.
3. MATERIAL OF THE THERMOWELL SHALL BE OF 316SS.
4. THERMOWELL SHALL BE DRILLED BAR STOCK TYPE.
5. INTERNAL BORE OF THE THERMOWELL SHOULD BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME PTC–19.3.
6. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESS AND TEMP AS PER ASME PTC–19.3.
7. THE 'U' & 'L' DIMENSIONS SHALL BE SELECTED BASED ON PARTICULAR APPLICATION.
8. ORIENTATION OF STUB ON VERTICAL/ HORIZONTAL PIPES SHALL BE 90° TO THE CENTRE LINE OF THE PIPES, FOR PIPE SIZE LARGER THAN 4". HEIGHT OF STUB SHALL BE 64mm FOR PIPE OD < 200Nb AND 45mm FOR PIPE OD ⩾ 200Nb.
9. STUB SHALL HAVE IBR CERTIFICATION, AS APPLICABLE, ACCORDING TO PROCESS DATA. 1
10. BOSS OD SHALL BE DEPENDENT ON PROCESS PRESS, TEMP & PIPE DIAMETER.
11. THERMOWELL SHALL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER Rc 1½.
12. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.

BHEL

TITLE :
INSTRUMENT STUB DETAILS FOR TEMPERATURE MEASUREMENT
(APPLICABLE FOR PIPE SIZE ABOVE 4")
[(i) DESIGN PRESS =/> 40 Kg/Cm2(g) OR (ii) DESIGN TEMP =/>400 DegC] 1

DRG. NO.
PE–DG–445–145–I101
REV. 01
SH. 5 OF 8 SHS.

TEMP. MEASUREMENT



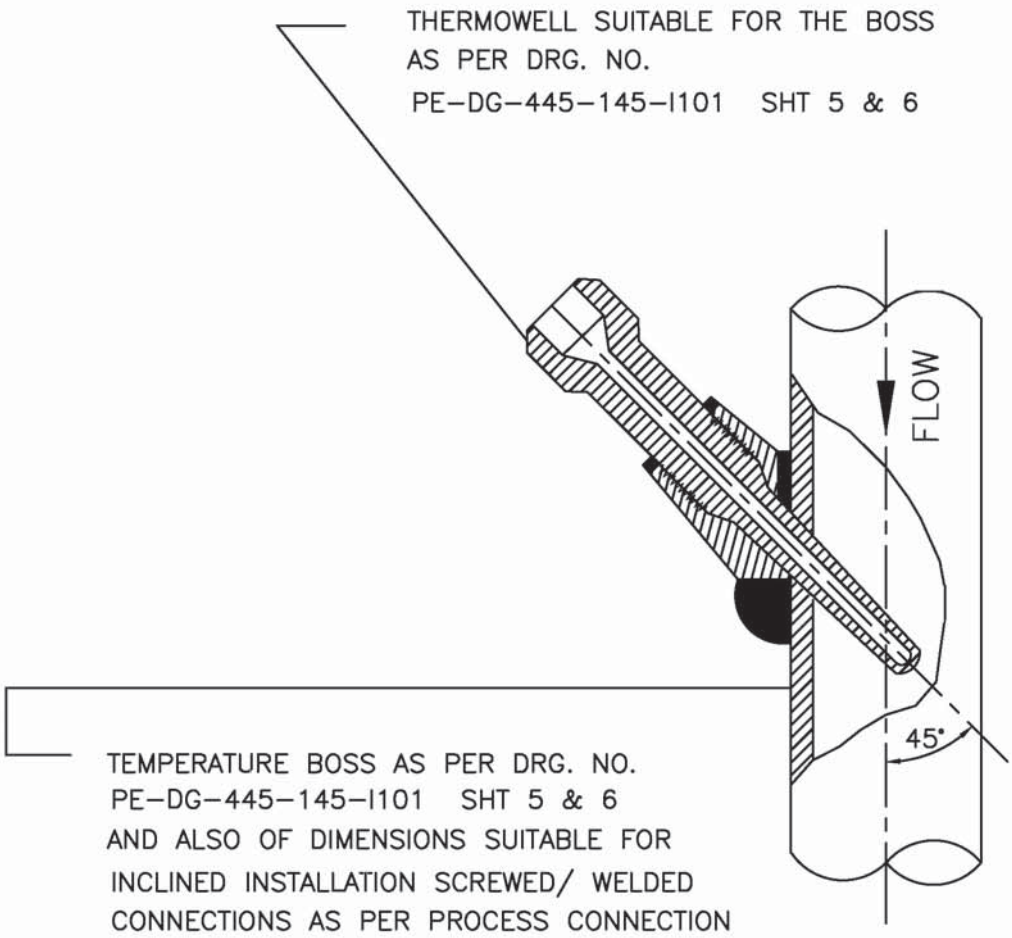
NOTES :–

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE DESIGN PRESS/ TEMP BELOW 40 KG/CM2(g)/400°C.
2. FOR PRESS. TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. SEE NOTES–2 TO 10 IN SHT. 5 OF 8 OF THIS DRG. 1
4. THERMOWELL SHALL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER Rc 1.
5. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.

BHEL

TITLE :
INSTRUMENT STUB DETAILS
FOR TEMPERATURE MEASUREMENT
(APPLICABLE FOR PIPE SIZE ABOVE 4")
[DESIGN PRESS < 40 Kg/Cm2 (g) & DESIGN TEMP < 400 C]

DRG. NO.
PE–DG–445–145–I101
REV. 01
SH. 6 OF 8 SHS.



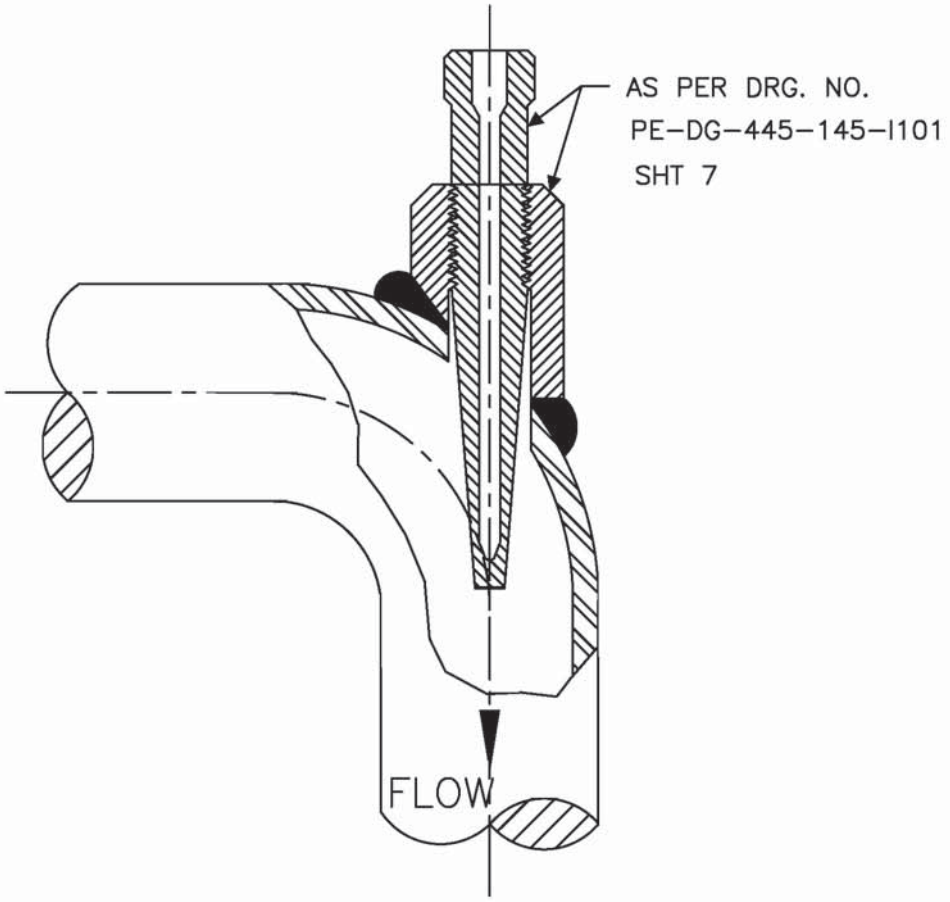
NOTES :–

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION TO BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (AT LEAST 3–4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDES OF THE INSTALLED THERMOWELL).

BHEL

TITLE :
INSTRUMENT STUB DETAILS
FOR TEMPERATURE MEASUREMENT
THERMOWELL INSTALLATION

DRG. NO.
PE–DG–445–145–I101
REV. 01
SH. 7 OF 8 SHS.



NOTES :–

1. THIS INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE. THIS DETAIL IS APPLICABLE FOR THERMOWELL INSTALLATION IN BEND PIPES. △1
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE TO BE USED FOR LIQUID SERVICE. FOR STEAM SERVICES EXPANDER SECTION TO BE USED IN VERTICAL PLANE.

BHEL

TITLE :
INSTRUMENT STUB DETAILS
FOR TEMPERATURE MEASUREMENT
THERMOWELL INSTALLATION

DRG. NO.
PE–DG–445–145–I101
REV. 01
SH. 8 OF 8 SHS.

INSTRUMENT INSTALLATION DRAWING

NOTES :

1..PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/TEMPERATURE REQUIREMENT. FOR LINE PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ.CM 2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.

2..MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY. ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION & SPECIFICATION V.IIE/S-VI/CLAUSE NO. 12.02.00..

3..DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB ASTM A 106 SCH 80 Gr.C. DRAIN HEADER SHALL BE TO THE NEAREST DRAIN PIT AS PER SITE CONDITION.

4..ALL FITTINGS SHALL BE WITH DOUBLE COMPRESSION FERRULE & NUTS.

5..UNION SHALL BE USED AT EVERY 6M INTERVAL OF IMPULSE LINE OR AS REQUIRED.

6..IMPULSE LINE SHALL BE SUPPORTED WITH U-CLAMPING AT EVERY 2.5M SPAN.

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	-	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

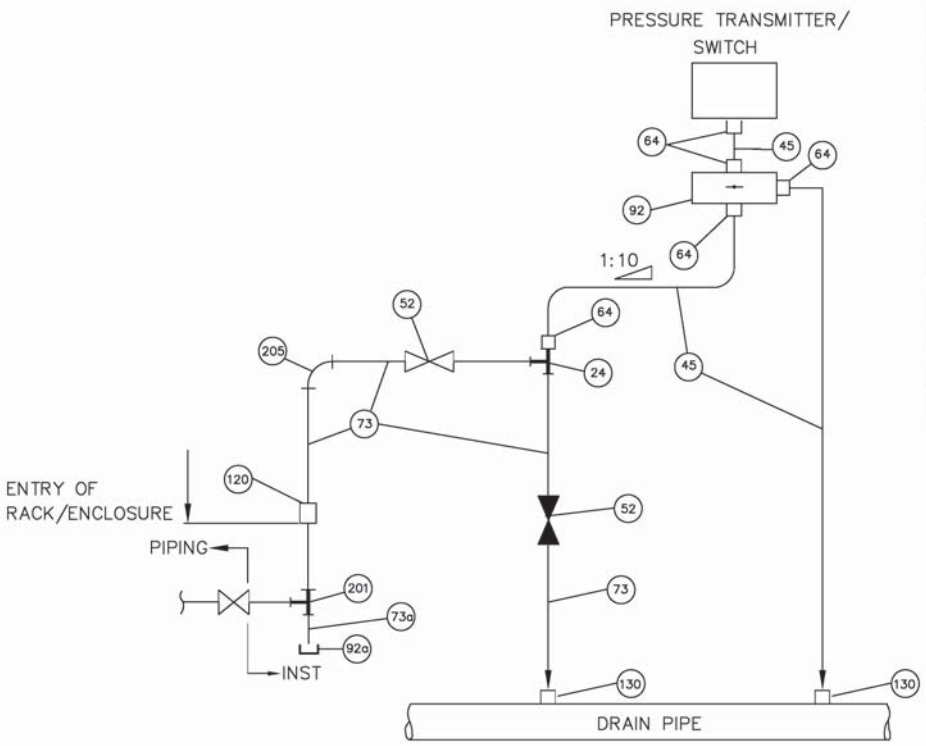
JOB NO. DCL- 12A05 | SCALE : NIL

DWG. NO. 12A05-DWG-I-0022 | REV. 0

12A05-DWG-I-0022-R-0-SHT-3 OF 27 C 22.06.2017

A3 (9-96) [420x297]

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	2	GLOBE VALVE, 1/2" SW
64	5	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD
73	15	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F), 150 MM
92	1	2-VALVE MANIFOLD, 1/2" NPT (F)
92a	1	DRAIN PLUG, 1/2" NPT (M)
120	1	BULK HEAD UNION/COUPLING, 1/2" SW
130	2	HALF COUPLING, 1/2" SW
201	1	EQUAL TEE, 1/2" SW
205	2	90° ELBOW, 1/2" SW

SERVICE : CONDENSER PRESSURE ETC.

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA
SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

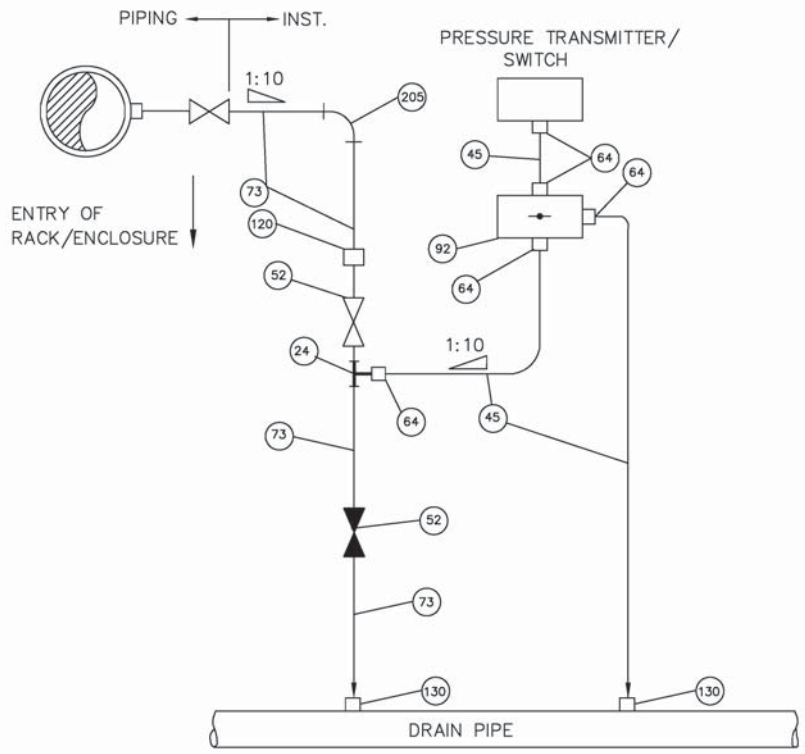
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL- 12A05 | SCALE : NIL
DWG. NO. 12A05-DWG-I-0022 | REV. 0

12A05-DWG-I-0022-4.0-SHT-4 OF 27 C 22.06.2017

A3 (9-96) [420x297]

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	2	GLOBE VALVES, 1/2" SW
64	8	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	15 M	IMPULSE PIPE, 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
120	1	BULK–HEAD UNION, 1/2" SW
130	2	HALF COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW

SERVICE : CONDENSATE, FEED WATER ETC.

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE–III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

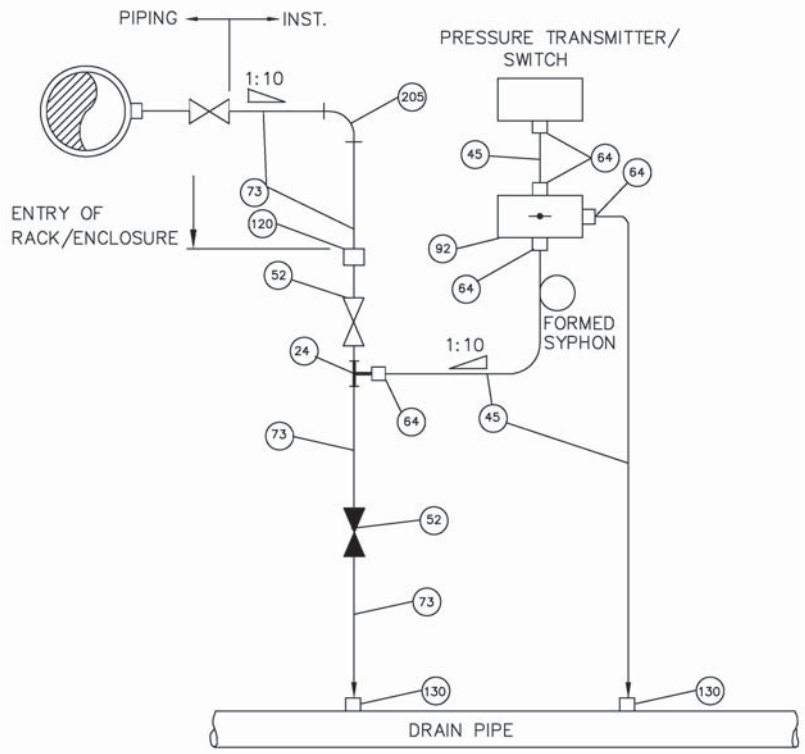
JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05–DWG–I–0022 | REV. 0

12A05-DWG-I-0022-R0-SHT-5 OF 27 C 22.06.2017

A3 (9–96) [420x297]

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



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	2	GLOBE VALVES, 1/2" SW
64	8	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	15 M	IMPULSE PIPE, 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
120	1	BULK-HEAD UNION, 1/2" SW
130	2	HALF COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW

SERVICE : LOW PRESSURE STEAM

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA
SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

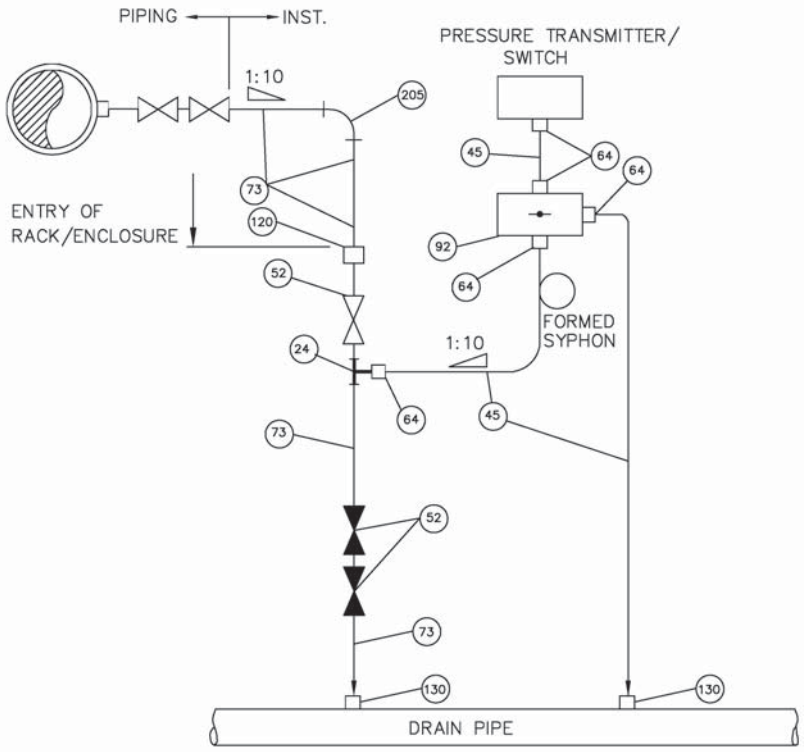
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL- 12A05 | SCALE : NIL
DWG. NO. 12A05-DWG-I-0022 | REV. 0

C 22.06.2017
D 12A05-DWG-I-0022-R-0-SHT-6 OF 27

A3 (9-96) [420x297]

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



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	3	GLOBE VALVES, 1/2" SW
64	8	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	15 M	IMPULSE PIPE, 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
120	1	BULK-HEAD UNION, 1/2" SW
130	2	HALF COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW

SERVICE : SERVICE : MEDIUM & HIGH PRESSURE STEAM

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

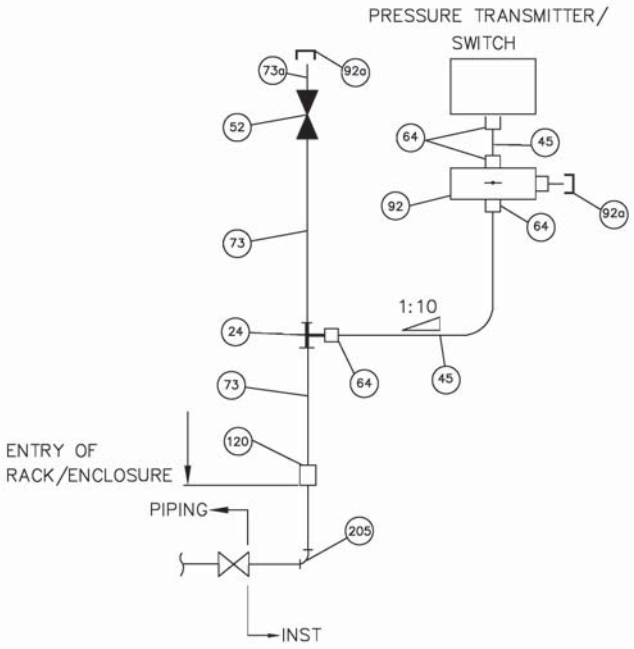
JOB NO. DCL- 12A05 | SCALE : NIL

DWG. NO. 12A05-DWG-I-0022 | REV. 0

12A05-DWG-I-0022-A-0-SHT-7 OF 27 C 22.06.2017

A3 (9-96) [420x297]

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	1	GLOBE VALVE, 1/2" SW
64	4	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD
73	15 M	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F), 150 MM
92	1	2-VALVE MANIFOLD, 1/2" NPT (F)
92a	2	VENT PLUG, 1/2" NPT (M)
120	1	BULK HEAD UNION/COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW

SERVICE : INSTRUMENT AIR

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA
SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

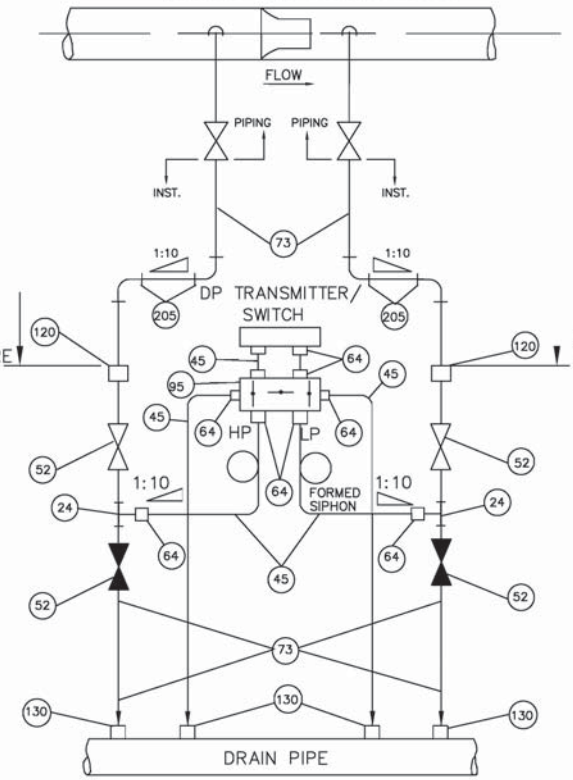
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL- 12A05 | SCALE : NIL
DWG. NO. 12A05-DWG-I-0022 | REV. 0

12A05-DWG-I-0022-R0-SHT-8 OF 27 C 22.06.2017

A3 (9-96) [420x297]

DIFF. PRESS. TRANSMITTER/DIFF. PRESS. SWITCH MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	2	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	6 M	TUBE, 1/2" OD
52	4	GLOBE VALVE, 1/2" SW
64	10	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	30 M	IMPULSE PIPE, 15 NB
95	1	5 VALVE MANIFOLD, 1/2" NPT (F)
120	2	BULK-HEAD UNION, 1/2" SW
130	4	HALF COUPLING, 1/2" SW
205	4	90° ELBOW, 1/2" SW

SERVICE : CONDENSATE,FEED WATER ETC.

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA
SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

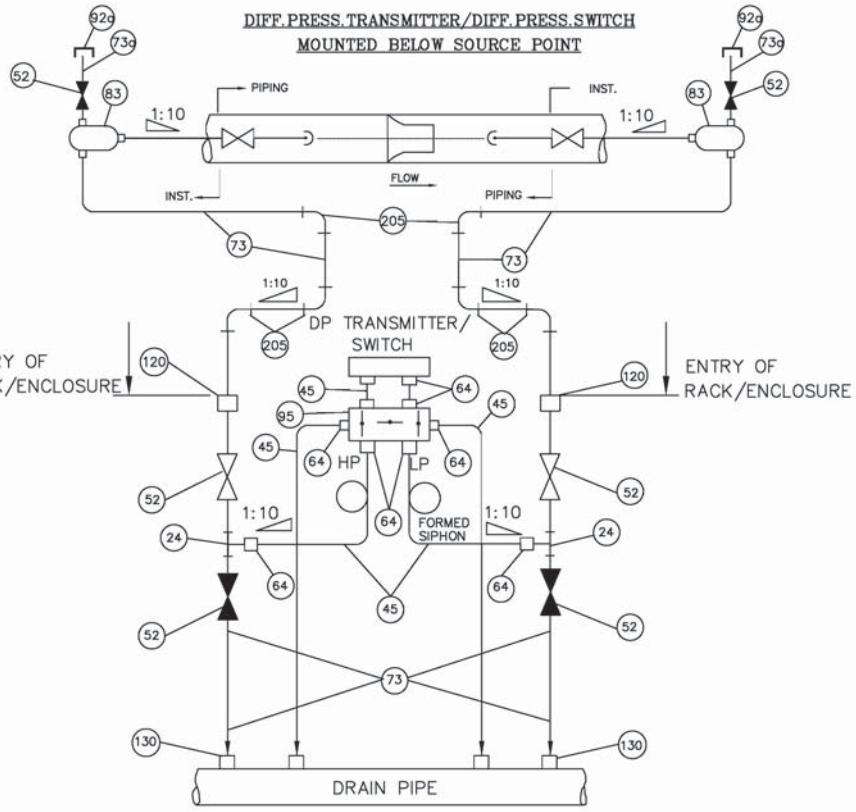
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL- 12A05 | SCALE : NIL
DWG. NO. 12A05-DWG-I-0022 | REV. 0

C 22.06.2017
12A05-DWG-I-0022-A-0-SHT-9 OF 27

A3 (9-96) [420x297]

DIFF.PRESS.TRANSMITTER/DIFF.PRESS.SWITCH
MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	2	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	6 M	TUBE, 1/2" OD
52	6	GLOBE VALVE, 1/2" SW
64	10	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	30 M	IMPULSE PIPE, 15 NB
73a	2	NIPPLE, 1/2" SW X 1/2" NPT (F), 150 MM
83	2	CONDENSING POT, 1/2" SW
92a	2	VENT PLUG, 1/2" NPT (M)
95	1	5 VALVE MANIFOLD, 1/2" NPT (F)
120	2	BULK-HEAD UNION, 1/2" SW
130	4	HALF COUPLING, 1/2" SW
205	6	90° ELBOW, 1/2" SW

SERVICE : STEAM

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA
SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

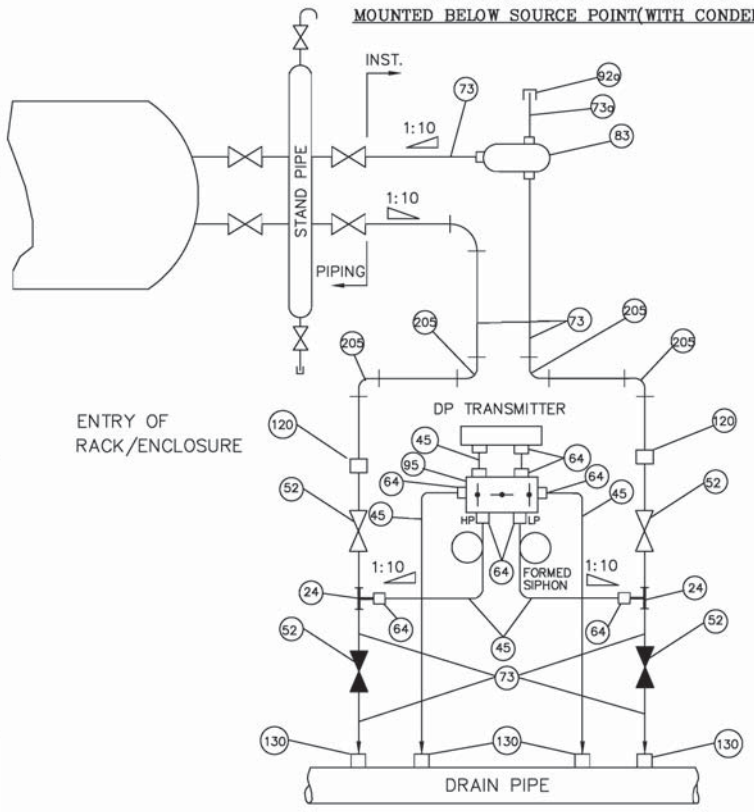
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL- 12A05 | SCALE : NIL
DWG. NO. 12A05-DWG-I-0022 | REV. 0

C 22.06.2017
12A05-DWG-I-0022-R0-SHT-10 OF 27

A3 (9-96) [420x297]

DIFF. PRESS. TRANSMITTER (LEVEL) MOUNTED BELOW SOURCE POINT(WITH CONDENSATE POT)



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	2	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	6 M	TUBE, 1/2" OD
52	4	GLOBE VALVE, 1/2" SW
64	8	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	30 M	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F)
83	1	CONDENSATE POT, 1/2" SW
92a	1	VENT PLUG, 1/2" NPT (M)
95	1	5 VALVE MANIFOLD, 1/2" NPT (F)
120	2	BULK-HEAD UNION, 1/2" SW
130	4	HALF COUPLING, 1/2" SW
205	5	90° ELBOW, 1/2" SW

SERVICE : SEPARATOR, DEAERATOR, HEATERS

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA
SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

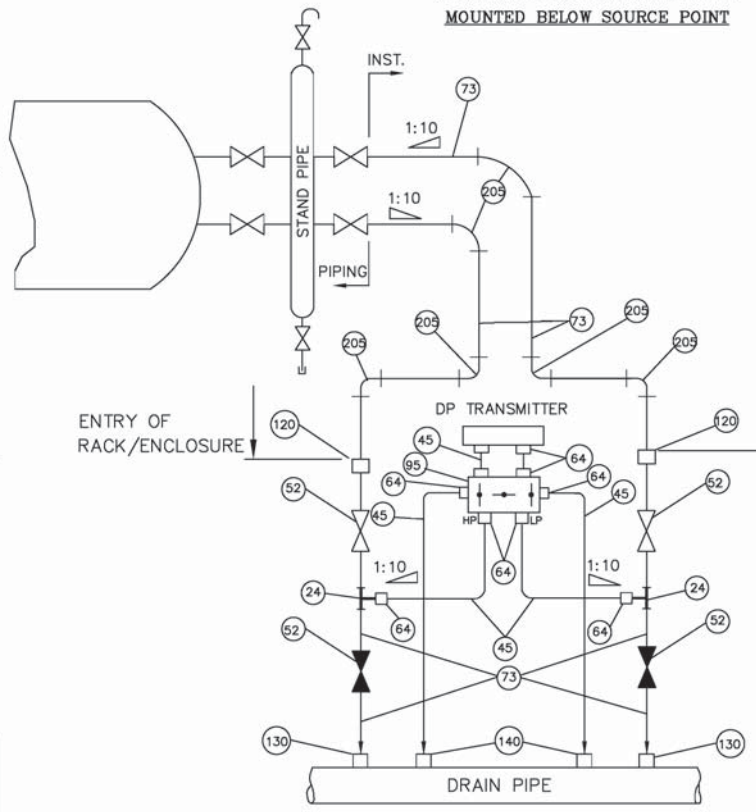
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL- 12A05 | SCALE : NIL
DWG. NO. 12A05-DWG-I-0022 | REV. 0

C 22.06.2017
12A05-DWG-I-0022-A-0-SHT-11 OF 27

A3 (9-96) [420x297]

DIFF.PRESS.TRANSMITTER (LEVEL) MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	2	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	6 M	TUBE, 1/2" OD
52	4	GLOBE VALVE, 1/2" SW
64	8	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	30 M	IMPULSE PIPE, 15 NB
95	1	5 VALVE MANIFOLD, 1/2" NPT (F)
120	2	BULK-HEAD UNION, 1/2" SW
130	4	HALF COUPLING, 1/2" SW
205	6	90° ELBOW, 1/2" SW

SERVICE : WATER

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

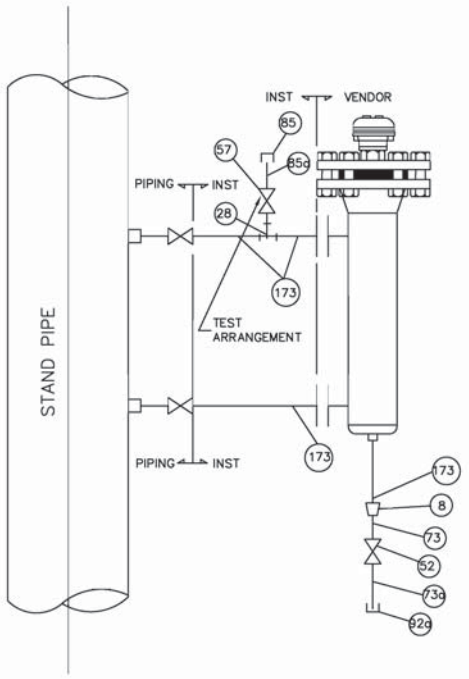
JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05-DWG-I-0022 | REV. 0

12A05-DWG-I-0022-R0-SHT-12 OF 27 C 22.06.2017

A3 (9-96) [420x297]

FLOAT OPERATED LEVEL SWITCH



BILL OF MATERIALS		
ITEM NO	QTY/ INST	DESCRIPTION
8	1	REDUCER, 1" SW X 1/2" SW
28	1	EQUAL TEE, 1" SW
52	1	GLOBE VALVE, 1/2" SW
57	1	GLOBE VALVE, 1" SW
73	1 M	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F)
85	1	PLUG, 1" NPT (M)
85a	1	NIPPLE, 1" SW X 1" NPT (F)
92a	1	DRAIN PLUG, 1/2" NPT (M)
173	1 M	IMPULSE PIPE, 25 NB

SERVICE : CONDENSATE

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

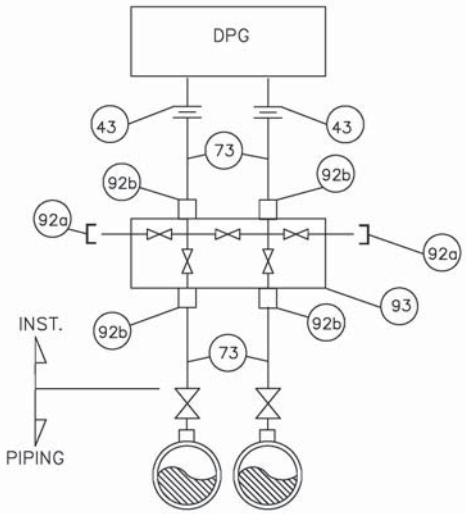
JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05–DWG–I–0022 | REV. 0

12A05-DWG-I-0022-0-SHT-13 OF 27 C 22.06.2017

A3 (9–96) [420x297]

DIFFERENTIAL PRESSURE GAUGE



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
43	2	THREE PIECE UNION, 1/2" SW X 1/2" NPT (F)
52	2	GLOBE VALVE, 1/2" SW
73	30 M	IMPULSE PIPE 15 NB
93	1	5 VALVE MANIFOLD, 1/2" NPT (F)
92a	2	VENT PLUG, 1/2" NPT (M)
92b	4	ADAPTOR, 1/2" SW X 1/2" NPT (M)

SERVICE : WATER, STEAM, AIR ETC.

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

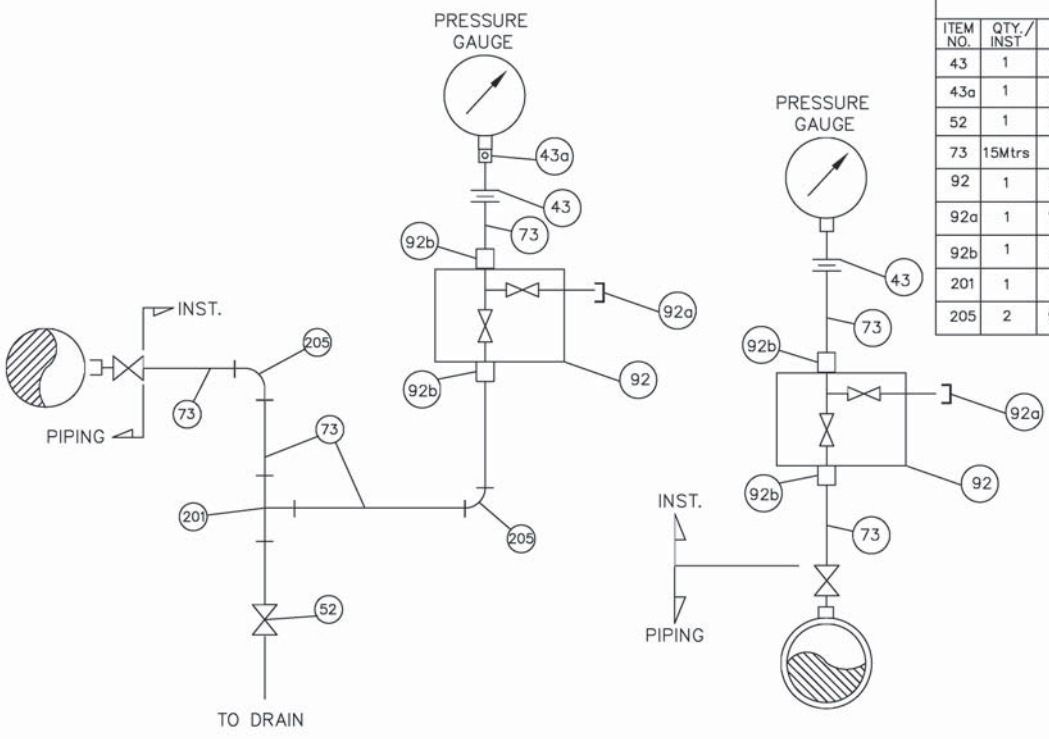
JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017 12A05-DWG-I-0022-A-0-SHT-14 OF 27

A3 (9–96) [420x297]

PRESSURE GAUGE



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
43	1	THREE PIECE UNION, 1/2" SW X 1/2" NPT (F)
43a	1	SNUBBER, 1/2" NPT (M) X 1/2" NPT (F) (AT PUMP DISCHARGE)
52	1	GLOBE VALVE, 1/2" SW
73	15Mtrs	IMPULSE PIPE 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
92a	1	VENT PLUG, 1/2" NPT (M)
92b	1	ADAPTOR, 1/2" SW X 1/2" NPT (M)
201	1	EQUAL TEE 1/2" SW
205	2	90° ELBOW 1/2" SW

SERVICE : WATER, CONDENSATE ETC.

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA
SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

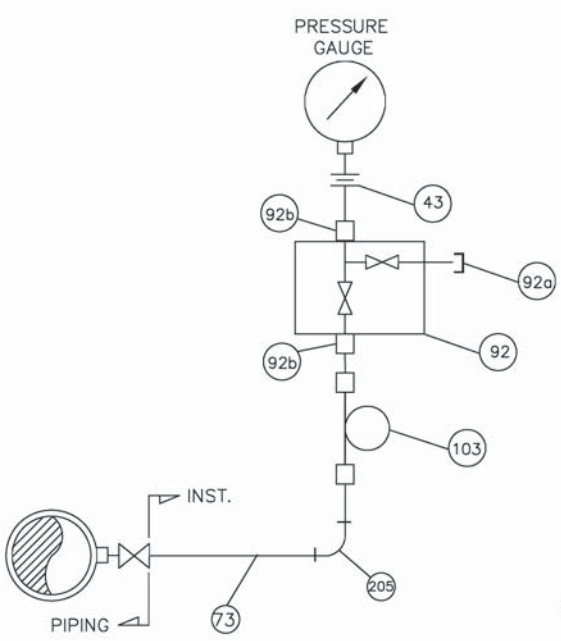
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL– 12A05 | SCALE : NIL
DWG. NO. 12A05–DWG–I–0022 | REV. 0

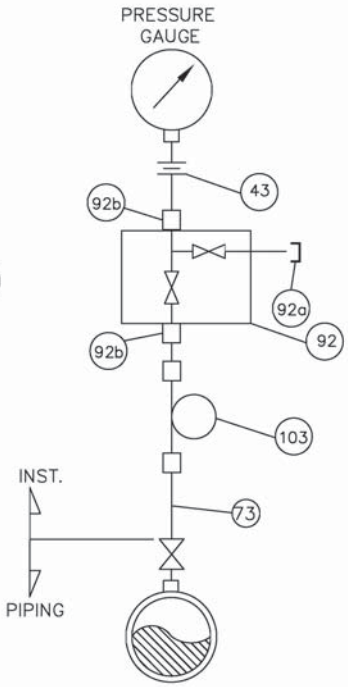
12A05-DWG-I-0022-A-0-SHT-15 OF 27 C 22.06.2017

A3 (9–96) [420x297]

PRESSURE GAUGE



REMOTE MOUNTING



ON TAP MOUNTING

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
43	1	THREE PIECE UNION, 1/2" SW X 1/2" NPT (F)
73	15Mtrs	IMPULSE PIPE 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
92a	1	VENT PLUG, 1/2" NPT (M)
92b	1	ADAPTOR, 1/2" SW X 1/2" NPT (M)
103	1	SYPHON 1/2" SW
205	1	90° ELBOW 1/2" SW

SERVICE : STEAM, FEED WATER

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL– 12A05 | SCALE : NIL

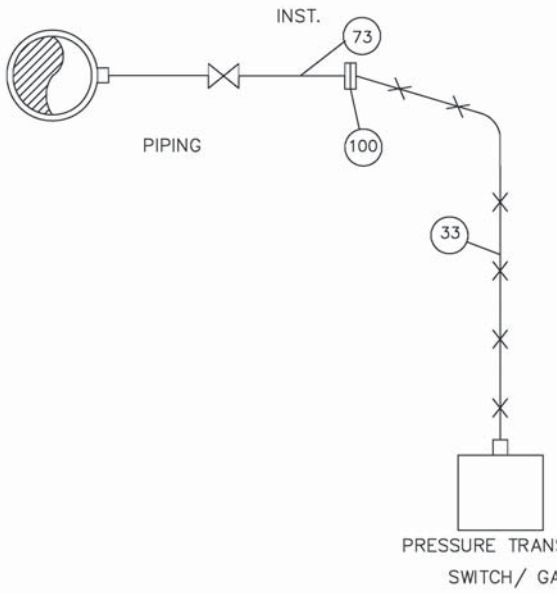
DWG. NO. 12A05–DWG–I–0022 | REV. 0

12A05-DWG-I-0022-A-0-SHT-16 OF 27 C 22.06.2017

A3 (9–96) [420x297]

PRESSURE TRANSMITTER/PRESSURE SWITCH WITH REMOTE DIAPHRAGM SEAL

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
33	A/R	SS ARMOURED CAPILLARY TUBE
73	1 M	IMPULSE PIPE, 15 NB
100	1	FLANGE ASSEMBLY TO SUIT 1/2" PIPE



SERVICE: CORROSIVE/ VISCOUS/SOLID BEARING OR SLURRY SERVICE

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

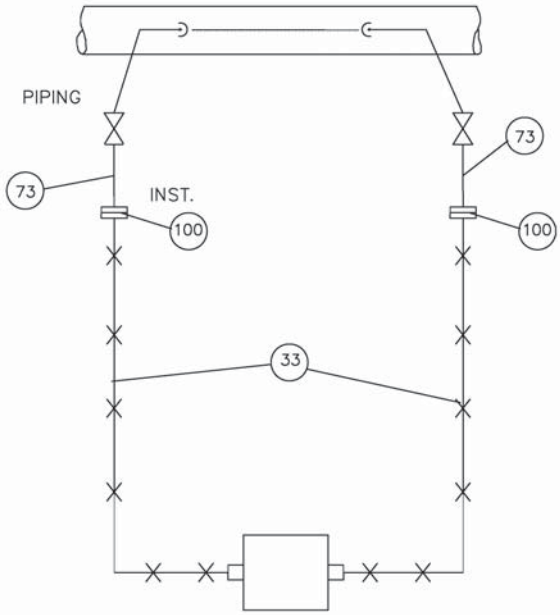
JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05–DWG–I–0022 | REV. 0

12A05-DWG-I-0022-A-0-SHT-19 OF 27 C 22.06.2017

A3 (9–96) [420x297]

DIFFERENTIAL PRESSURE TRANSMITTER/DIFFERENTIAL PRESSURE SWITCH



DIFFERENTIAL PRESSURE TRANSMITTER/
SWITCH/ GAUGE

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
33	A/R	SS ARMOURED CAPILLARY TUBE
73	2 M	IMPULSE PIPE, 15 NB
100	2	FLANGE ASSEMBLY TO SUIT 1/2" PIPE

SERVICE: CORROSIVE/ VISCOUS/SOLID BEARING OR SLURRY SERVICE

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

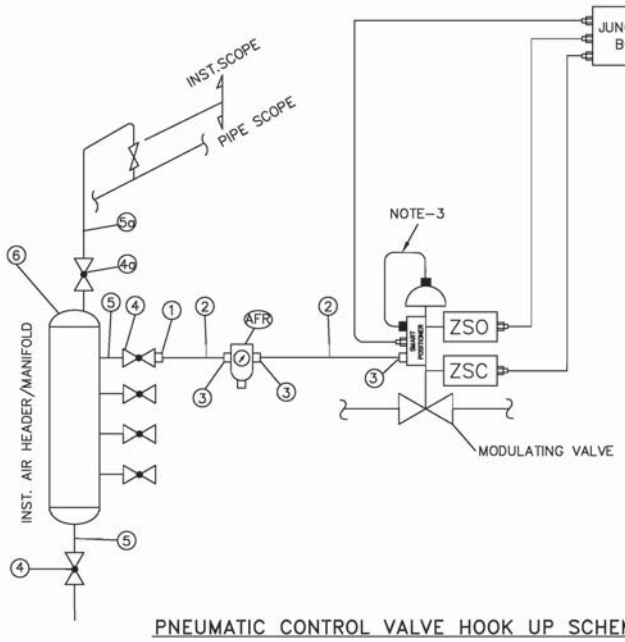
TYPICAL INSTRUMENT INSTALLATION DIAGRAM
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA
SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL– 12A05 | SCALE : NIL
DWG. NO. 12A05–DWG–I–0022 | REV. 0

12A05-DWG-I-0022-R0-SHT-20 OF 27 C 22.06.2017

A3 (9–96) [420x297]



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD	1	
2	TUBE	6 mm OD X 1 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD	3	
4	ISOLATION VALVE	BALL TYPE 1/2" SW X 1/2" NPT(F)	2	
4a	ISOLATION VALVE	BALL TYPE 1" SW	1	
5	PIPE	1/2" NB	A/R	
5a	PIPE	1" NB	A/R	
6	AIR MANIFOLD	2" NB	1	

PNEUMATIC CONTROL VALVE HOOK UP SCHEME

NOTES.

1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.
4...LIMIT SWITCHES WILL BE CONNECTED WHEREVER APPLICABLE.
5...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
6...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

FOR TENDER PURPOSE ONLY

REVIEWED	A.T.	S.B.	A.K.P.	S.K.	DESCRIPTION	RELEASE STATUS	REV.	DATE
	APPROVED	REVIEWED	CHECKED	DRAWN	FIRST ISSUE	–	0	22.06.2017

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KOLKATA, INDIA
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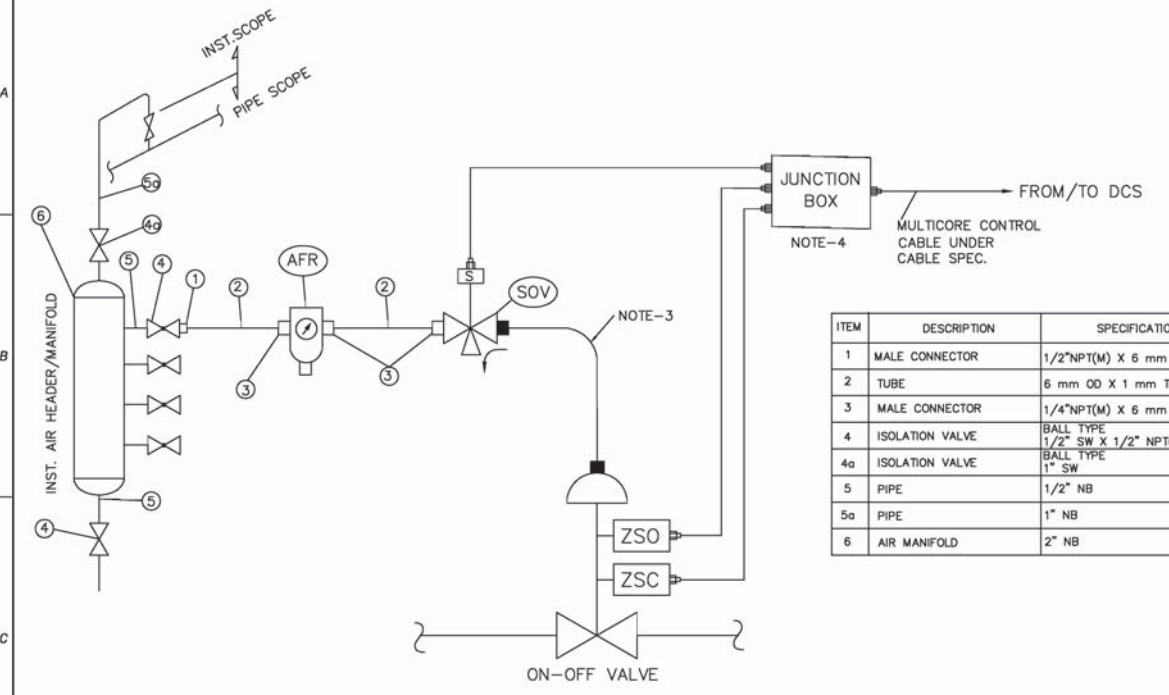
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL– 12A05 | SCALE : NIL
DWG. NO. 12A05–DWG–I–0022 | REV. 0

12A05-DWG-I-0022-0-SHT-26 OF 27 C 22.06.2017

A3 (9–96) [420x297]



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
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3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD	3	
4	ISOLATION VALVE	BALL TYPE 1/2" SW X 1/2" NPT(F)	2	
4a	ISOLATION VALVE	BALL TYPE 1" SW	1	
5	PIPE	1/2" NB	A/R	
5a	PIPE	1" NB	A/R	
6	AIR MANIFOLD	2" NB	1	

PNEUMATIC SOV HOOK UP SCHEME

NOTES.

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

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

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DWG. NO. 12A05–DWG–I–0022 | REV. 0

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A3 (9–96) [420x297]

SECTION III

	TITLE: **1 X 660 MW SAGARDIGHI TPS UNIT NO. 5 PHASE III**	SPECIFICATION NO. PE-TS-445-155A-A001	
		SECTION : III	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	**SUB-SECTION:**	
		REV. NO. 01	DATE : 13.07.2021

SCHEDULE OF PRE-BID CLARIFICATION

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

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

Note: Bidder to furnish all the pre-bid clarifications in the above indicated pre-bid clarification format only. General pre-bid clarifications will not be considered.

COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

a.) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.

b.) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.

c.) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/ Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.

d.) There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.

e.) The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.

f.) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).

g.) All sub vendors shall be subject to BHEL/ CUSTOMER approval.

h.) Any special tools & tackles, if required, shall be in bidder's scope.

i.) Demonstration parameters shall stand valid till the satisfactory completion of demonstration test and its acceptance by BHEL/ Customer.

BHEL	**TITLE:** **1 X 660 MW SAGARDIGHI TPS UNIT NO. 5 PHASE III**	SPECIFICATION NO. PE-TS-445-155A-A001	
		SECTION : III	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	**SUB-SECTION:**	
		REV. NO. 01	DATE : 13.07.2021

DECLARATIONS

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

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

Bidders Company Name …….

Authorized representative's signature

..……..

Name …….

Bidder's name

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

THIS IS A PART OF TENDER TECHNICAL SPECIFICATION NO. PE-TS-445-155-A001

SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL

PROJECT:- 2X800 MW UPPUR STPP

CONDENSATE POLISHING UNIT

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF withdrawal OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF withdrawal OF DEVIATION IS APPLICABLE	NATURE OF COST OF withdrawal OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawal is to be given seperately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.