



Specific Technical Requirement
For
Compressed Air System

4X270MW TPP
BHADRADRI,
TELANGANA

1. **Complete C&I system** for Compressed Air System is in bidder scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder.
2. Integrated microprocessor based control system along with suitable operator interface shall be provided for each Instrument Air Compressor & Service Air Compressor. All PT, DPT, TE, and other instruments outside the compressor skid shall also be hooked-up to this system. Dual two way Ethernet connectivity to DCS shall be provided through optical fiber link for information and overall control of air compressors. Protocol OPC for connectivity to DCS shall be applicable. In addition to the soft link, provision for hardwired START, STOP and LOAD & UNLOAD commands from DCS to all the compressors & their status feedbacks to DCS shall also be provided. Bidder to furnish the configuration diagram of control system of compressor showing communication with DCS along with the bid.
3. Fiber optic cable between DCS & compressor system along with both side connectors shall be provided by BHEL. Bidder to ensure the provision for same in their system.
4. The requirements given are to be read in conjunction with detailed Technical specification enclosed.
5. The scope of cable shall be referred in Electrical scope split sheet in Electrical portion of the specification.
6. Group control is envisaged to clock more or less or equal number of running hours for each air compressor, hence the necessary logic/control scheme, write-up and HMI graphics for overall operation of the compressor from DCS is to be submitted by the bidder during detailed engineering.
7. Plant schematic for monitoring & operation shall be available on all the OWS. Bidder to further submit list of signals along with applicable schematic for monitoring in DCS.
8. Bidder to include all the instruments (PG, PS, LS, TS, Dew Point meter etc.) required for the package along with fittings, accessories and valve manifold.
9. The solenoid operated valves shall have limit switches for open/ close feedback.
10. All motor operated valves/electric actuators shall be envisaged with integral starter. Typical Hook Up diagram of all types of drives is attached for use (subject to Customer approval).
11. All pneumatic operated regulating control valves shall be envisaged with smart positioner.



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12. The junction boxes for termination of instruments /actuator limit switches/solenoid valve limit switches etc. are in bidder's scope.
13. Bidder to provide RTDs (PT-100) for bearing & winding temperature measurements of Fans, Pumps, H.T. motors & other equipment. The winding and bearing temperature sensors of all compressor motors shall be hooked-up to the DCS for monitoring through softlink.
14. 415V, 3Ø AC supply shall be provided by BHEL at a single point, further distribution to various instruments/equipments of the CAS shall be in Bidder's scope. Bidder to include the necessary power distribution board in his scope. Any power supply other than the above, if required for any instrument/equipment has to be derived from the above supply & all the necessary hardware for the same shall be in Bidder's scope.
15. Power supply derived for Transmitters, contact interrogation, interposing relay and solenoid shall generally be ungrounded 24V D.C only. In all cases redundancy in power modules shall be considered.
16. Bidder to note that all the transmitters/instruments supplied by Bidder shall be rack mounted. The racks shall be preassembled and provided by Bidder. Also no instruments / analyzers & JB's/Racks should be protruding on the walkway.
17. Instrument installation and accessories required and same shall be in Bidder's scope and shall be subject to customer/BHEL approval during detailed engineering.
18. Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.
19. Bidder shall provide Cable Schedule in BHEL excel format which shall be provided during detailed engineering. Also, Cable Interconnections for Complete System shall be in Bidders' scope. DCS side details for hardwired signals shall be furnished by BHEL during detailed engineering.
20. Participation of bidder's personnel and experts as well as experts from their collaborator in discussion with Owner / consultant and other equipment vendors during various stages of contract implementation as required by the Owner to achieve desired C&I system configuration and performance is in Bidder's scope.
21. The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with. In case of any contradiction most stringent clause/condition shall prevail.



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22. Typical Drive Control Philosophy is provided in section D, 1.3. Same shall be used by bidder for deciding signal interface between Microprocessor panel & MCC/SWGR and between DCS & Solenoid valve/Actuator/Analog drive.

23. Drawings/Documents and data to be furnished after award of the contract:

1. Control & operational write-up for the system
2. System Configuration Diagram
3. Recommended control scheme/ block logic diagram
4. Process manuscript for implementation in DCS
5. Drive List and I/O list
6. Power requirement and grounding scheme
7. Field instruments quality plan
8. Electrical Wiring Diagram for Compressor LCP
9. Signal exchange list and dually filled checklist (shall be provided by BHEL during detailed engineering) for softlink to DCS through OPC/MODBUS
10. Instruments data sheet
11. JB/LIE/LIR Grouping document
12. Cable schedule (BHEL format) and cable interconnection drawing
13. Instrument schedule
14. Any other document decided during detailed engineering.

Notes:

1. All equipment items shall be of latest design with proven on track record.
2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.
3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.
4. In case of any discrepancy in Section-C and Section-D of the specification, Section-C shall prevail.



SPECIFIC TECHNICAL REQUIREMENT ANNEXURE

SPEC NO.:

SECTION IC

REV. NO.

00

DATE : 24.03.2017

SHEET

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SPECIFIC TECHNICAL REQUIREMENTS

SENSOR REDUNDANCY

Following redundancy criteria shall be met:

1. Two out of three measurements philosophy shall be adopted for all CLCS (Closed Loop Control System) and Protection for reliability of operation. The control system shall select the median value for the normal control purpose. In case of deviation of one transmitter output from the other two, the same shall be automatically isolated and average output of the remaining transmitters shall be fed to the control and measurement system and the control loop in this case shall be maintained on auto, with an alarm on the operator's work station as well as on the engineer's station. In case of failure of the two remaining transmitters in circuit, deviation of one transmitter output is more than the pre-set limit compared to the other transmitter, there shall be automatic bump less transfer to manual and Changeovers shall have suitable alarms in the operator's work station as well as engineer's station.
2. For signal compensations, separate signals from separate transmitters other than used for measurement & control shall be used.
3. For OLCS (Open Loop Control System) all sensors used for the protection shall be triple redundant All sensors for permissive and interlock shall be dual redundant.

GENERAL POINTS:

1. The Instrumentation furnished in the PID is a minimum requirement however any instrument required for completeness of the system shall be provided by bidder without any cost implication. The requirement shall be decided during detailed engineering.
2. Solenoid Valves shall be mounted in Pneumatic Junction Boxes only and Pneumatic Junction box shall be in the scope of bidder. (Typical photo of Pneumatic Junction Box is attached for ready reference)
3. LIE/LIR shall be provided for mounting of the instrument and LIE/LIR shall be in the scope of bidder.





Technical specification for
CONTROL & INSTRUMENTATION
4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

REV. NO. 00

DATE : 24.03.2015

SECTION-IC

ACTUATOR SPECIFICATION

VOLUME: V-A

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

1.00.00 SCOPE

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

2.00.00 STANDARDS

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

3.00.00 SERVICE CONDITIONS

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

4.00.00 RATING

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

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

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

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

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

6.02.00 **Motor**

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

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

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

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

8.00.00 **TEST**

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

9.00.00 **DRAWINGS, DATA & MANUALS**

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

9.02.00 **To be submitted with Bid**

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

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

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

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

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

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

2.0 RANGE OF VARIATION

A.C. Supply :

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

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

D.C. Supply :

Voltage	:	187 to 242
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Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

REV. NO. 00

DATE : 24.03.2015

ACTUATOR DATA SHEET



SPECIFICATION FOR MOTORISED VALVE ACTUATOR

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

VOLUME

SECTION

REV. NO.

00

DATE: 14.11.14

SHEET

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OF

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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)

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GENERAL*	* PROJECT	4X270 MW BHADRADRI TPS		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	☐ ON / OFF REQUIRED ☐ INCHING (AS REQUIRED)		
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
	CONSTRUCTION AND SIZING	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
BEARINGS		DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION		METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
SIZING		OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING(REGULATING) SERVICE 150 STARTS/HR MINIMUM		
HANDWHEEL		* REQUIRED	☒ YES ☐ NO	
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED		
	TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT.		
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED (BIDDER TO CONFIRM) A: ☒ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11		
	COLOUR SHADE	☒ BLUE (RAL 5012) ENAMEL ☐		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED INTERNALLY		
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 65 ☒ IP 67 ☐ FLAME PROOF ☐ IP 55, TOTALLY ENCL, SELF VENTILATED.		
	@ INSULATION CLASS	☐ CLASS-B ☒ CLASS-F (TEMP. RISE LIMITED TO CLASS B)		
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☐		



SPECIFICATION FOR MOTORISED VALVE ACTUATOR

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

VOLUME

SECTION

REV. NO.

00

DATE: 14.11.14

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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)

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	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED		
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED		
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS		
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)		
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED		
	OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED		
	STOP PB	☒ REQUIRED ☐ NOT REQUIRED		
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED		
	LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED		
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED		
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)		
INTERPOSING RELAY (Applicable for integral Starter)	INTERPOSING RELAYS	REQUIRED		
	INTERPOSING RELAY (QUANTITY)	☐ 2 NOs. ☒ 3 NOs.		
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC		
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX		
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms		
TORQUE SWITCH	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos		
	CONTACT TYPE	2 NO + 2 NC		
	RATING	5A 240V AC AND 0.5A 220V DC		
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE		
	ACCURACY	+3% OF SET VALUE		
LIMIT SWITCH	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN : INT : CLOSE	☒ 1 No ☐ 2 Nos.	2 Nos. (ADJ.) ☒ 1 No. ☐ 2Nos.	
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		



SPECIFICATION FOR MOTORISED VALVE ACTUATOR

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

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SHEET 3 OF 3

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

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

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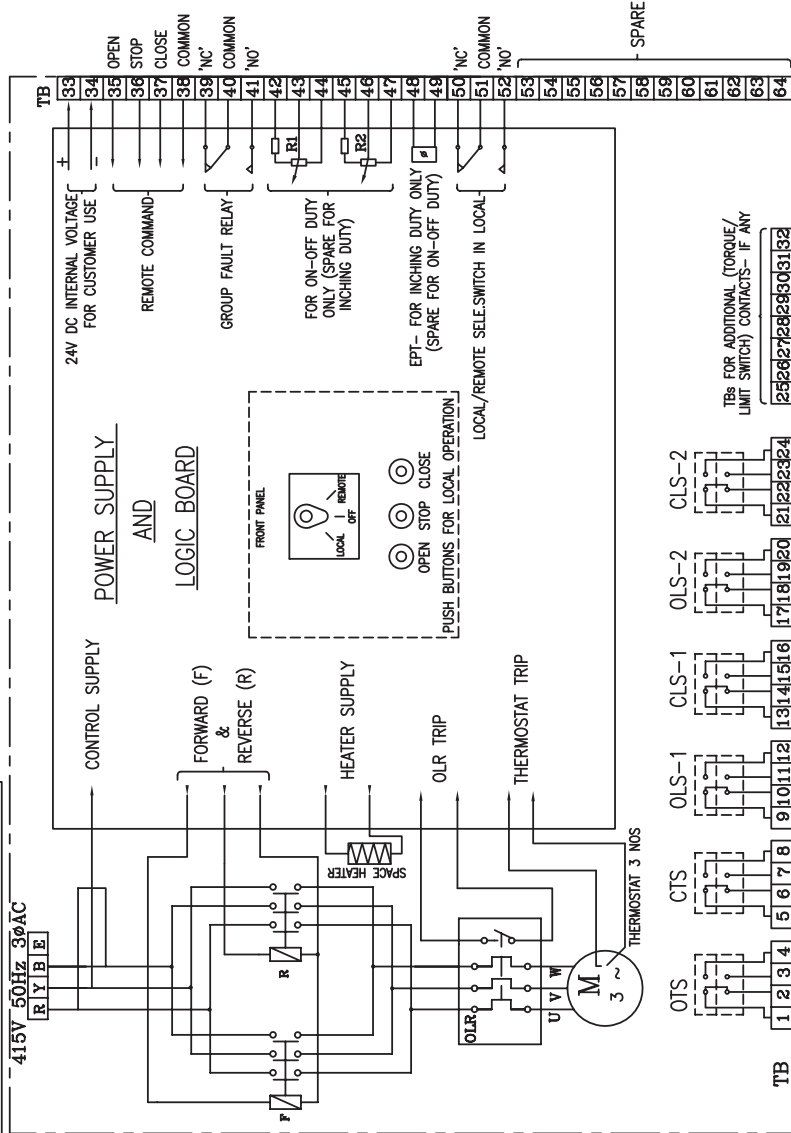
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty)	☒ REQUIRED ☐ NOT REQUIRED		
	MFR & MODEL NO.	BIDDER TO SPECIFY		
	TYPE	☒ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS		
	SUPPLY	☒ 24V DC ☐		
	OUTPUT	☒ 4-20mA		
	ACCURACY	± 1% FS		
SPACE HEATER	@SPACE HEATER	REQUIRED		
	@ POWER SUPPLY			
	@ RATING	415v, 3PH, AC FOR RATING > 0.2KW; SINGLE PHASE FOR RATING < 0.2KW		
TERMINAL BOX	MOTOR TERMINAL BOX	REQUIRED		
	ACTUATOR TERMINAL BOX	REQUIRED		
	ENCL CLASS MTR T.B. / ACTUATOR T.B.	@ ☒ IP 67 @ ☐	☒ IP67 ☐	
	@ EARTHING TERMINAL	REQUIRED		
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☒ NOT REQUIRED ☐ 2 NOS. ☐		
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:--DURING DETAIL ENGINEERING		
	@ SPACE HEATER CABLE GLAND	SIZE: 2C x 2.5 sq. mm		
	OTHER CONTROL CABLE GLANDS-1	INSTRUMENT CABLE SIZE FOR ON/OFF DUTY VALVES SHALL BE 8PX0.5 SQMM - ONE CABLE GLAND OF OD SIZE 20 MM. INSTRUMENT CABLE SIZE FOR INCHING DUTY TYPE VALVES SHALL HAVE TWO NO. CABLES (ONE NO. 8PX0.5 SQMM AND 2ND 2PX0.5 SQMM) - TWO NO. GLANDS OF OD SIZES 20 MM & 15 MM.		
	OTHER CONTROL CABLE GLANDS-2			
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.

NOTES:

- SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
- CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
- TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
- CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
- THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
- THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
- THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

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

DRAWING NO. 3-V-MISC-24227



SWITCH TERMINALS FOR CUSTOMER USE

NOTE:-

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

CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	OPEN
	11-12	STOP
CLS-1	13-14	CLOSE
	15-16	COMMON
OLS-2	17-18	OPEN
	19-20	STOP
CLS-2	21-22	CLOSE
	23-24	COMMON
SWITCH NO.	TERMINAL NO.	INTERMEDIATE POSITION
	a	b
FULL OPEN	FULL CLOSE	FULL CLOSE

INDICATES CONTACT CLOSED
INDICATES CONTACT OPEN

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

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

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

Bharat Heavy Electricals Ltd., UNIT: HIGH PRESSURE BOILER PLANT, TIRUCHIRAPPALLI-620014.	DRN	N.P.ESWAR	SIGN	N.P.	DATE	NO. OF
	CHD	D.DINAKARAN	D.D.	07.10.04	07.10.04	VAR
365-121	APPD	KARUNACHALAM	K.A.	07.10.04	07.10.04	

DEPT	VL	SCALE	WEIGHT (KG)	REFERENCE INFORMATION	NO. OF
CODE					THICK

REV	DATE	ALTERED	CHD & APPD

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



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPP, TELANGANA

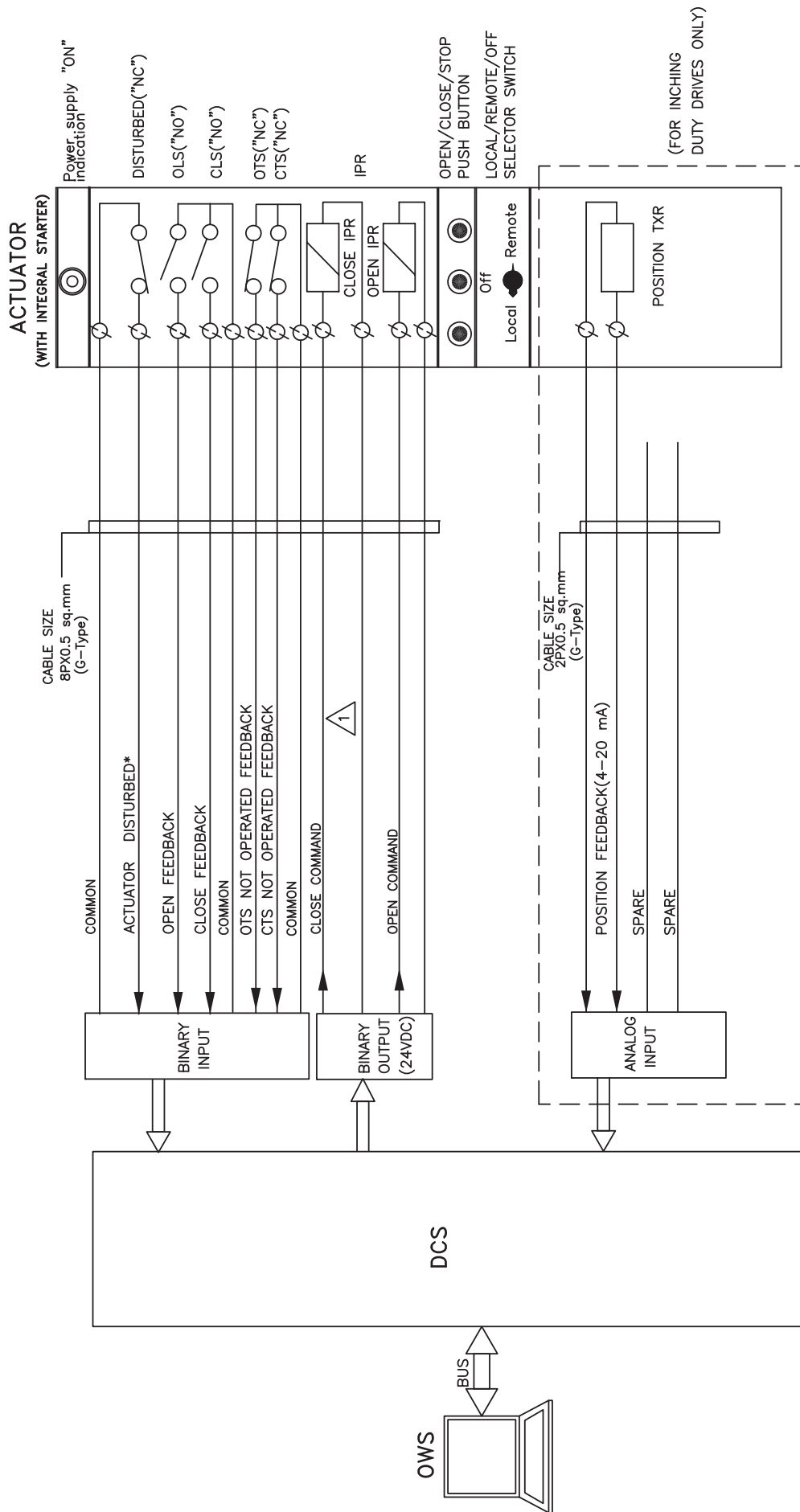
SECTION D

REV. NO. 00

DATE : 24.03.2015

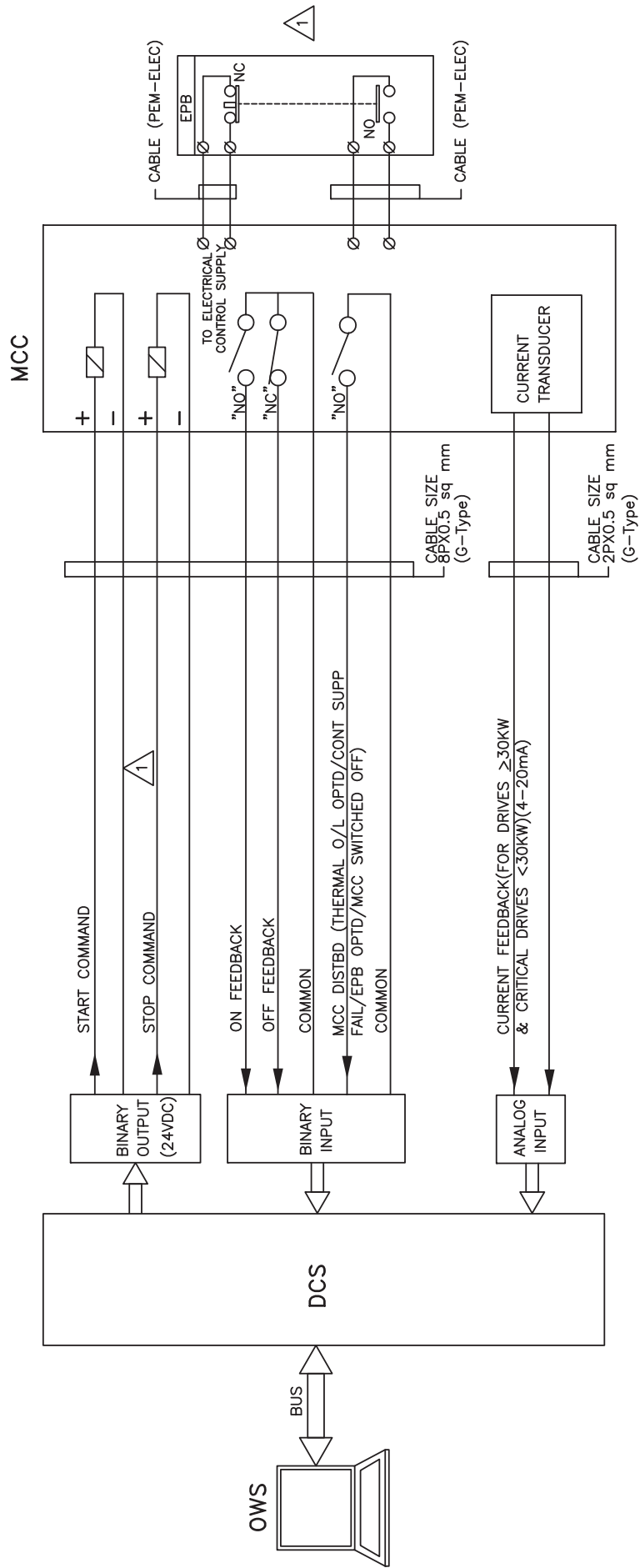
DRIVE CONTROL PHILOSOPHY

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



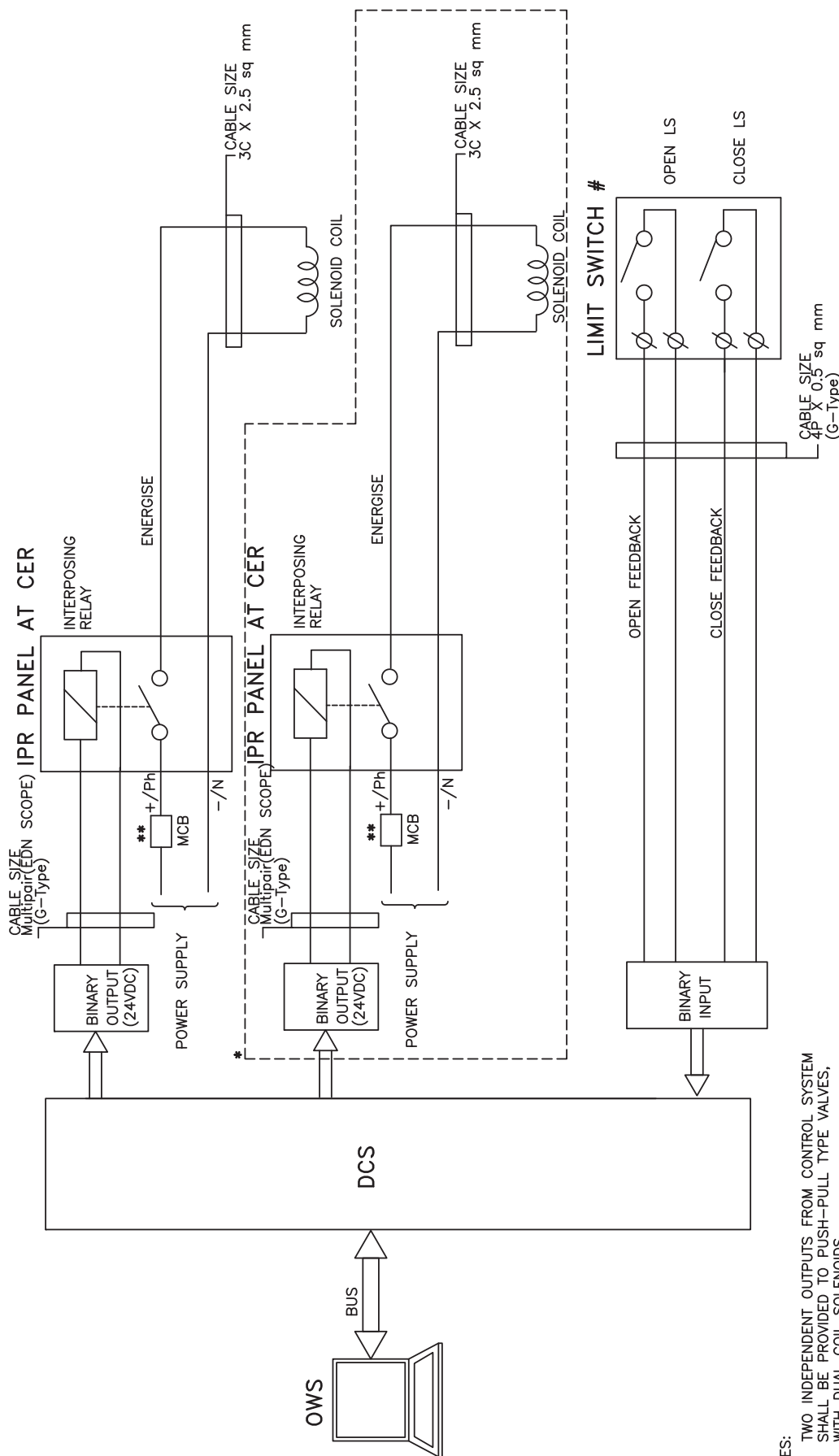
	PROJECT: 4 X 270 MW BHADRADRI TPS			DRG.NO.	PE-DM-411-145-1002	
	TITLE			DATE	06.02.2015	
	DDCMS INTERFACE FOR BIDIRECTIONAL DRIVE			REV.NO.	01	
				SHT	7	OF 11

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



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

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



- NOTES:
- * TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.
 - ** MCB SHALL BE PROVIDED FOR EACH SOLENOID
 - # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.



PROJECT: 4 X 270 MW BHADRADRI TPS

TITLE DDCMIS INTERFACE FOR SOLENOID DRIVE

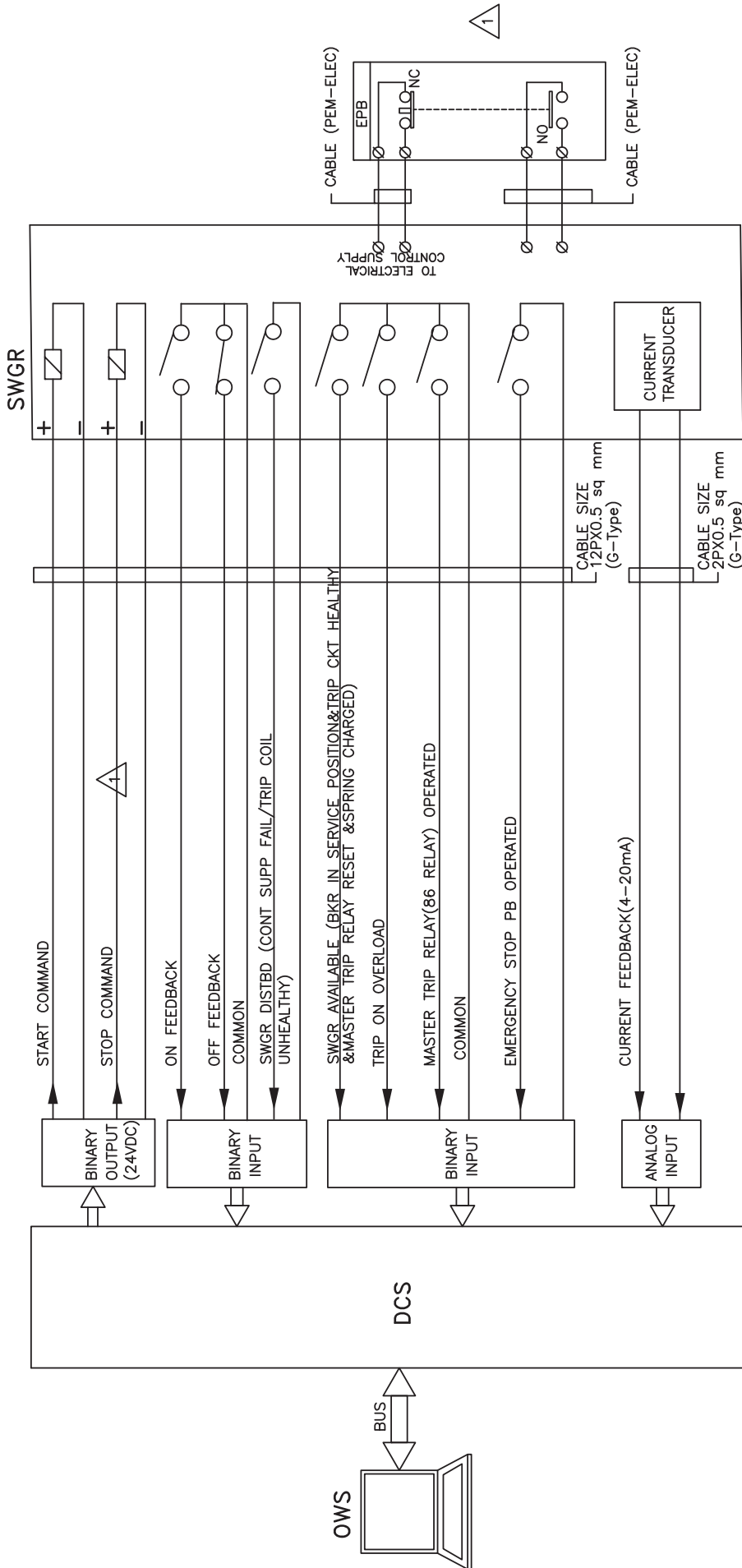
DRG.NO. PE-DM-411-145-1002

DATE 18.11.2014

REV.NO. 00

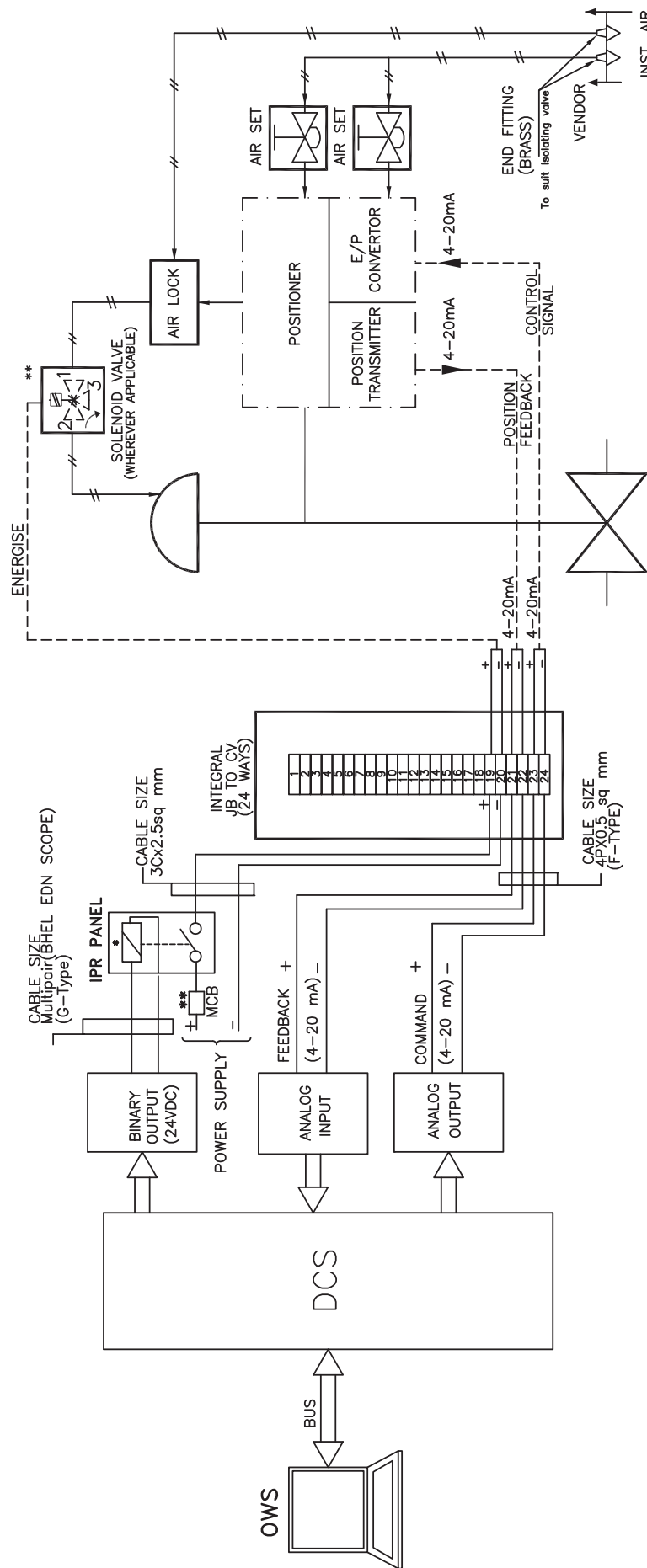
SHT 9 OF 11

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



	PROJECT: 4 X 270 MW BHADRADRI TPS	DRG.NO.:	PE-DM-411-145-I002
	TITLE	DATE	06.02.2015
	DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	REV.NO.	01
		SHT	10 OF 11

DCS INTERFACE FOR ANALOG DRIVE



NOTES:

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



PROJECT: 4 X 270 MW BHADRADRI TPS

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

DATE 18.11.2014

REV.NO. 00

SHT 11 OF 11

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



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

REV. NO. 00

DATE : 24.03.2015

INSTRUMENTATION DATA SHEET

1.00.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTERS**

1.01.00 PRESSURE TRANSMITTER

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

- | | | |
|-----|-------------------------------------|--|
| ii. | Repeatability | ± 0.05% of Span or better |
| 17. | Sealing/Isolation | : Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications |
| 18. | Accessories | : <ul style="list-style-type: none"> a. Universal mounting bracket suitable for 2" pipe mounting b. High tensile carbon steel U-bolts c. Siphon for steam and hot water services d. ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock e. Companion flange with nuts, bolts and gaskets f. ½" NPT cable gland g. Handheld calibrator |
| 19. | Adjustment/Calibration/ Maintenance | : From handheld calibrator/ HART management system |

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

1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER

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

-
- | | | | |
|-----|---------------------|---|---|
| 5. | Element material | : | SS-316 (Stainless Steel) or better |
| 6. | Static Pressure | : | 150 % of maximum span continuously, without affecting the calibration |
| 7. | Turn-down ratio | : | 100: 1 |
| 8. | Span and Zero | : | Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span |
| 9. | Enclosure Class | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 10. | Output Indicator | : | LCD (Integral indicator of 5 digit display) |
| 11. | Nameplate | : | Tag number, service engraved in SS tag plate |
| 12. | Body | : | SS |
| 13. | Operating Voltage | : | 24V DC |
| 14. | Load | : | 600 Ohms (min.) at 24 Volts D.C. |
| 15. | Ambient Temperature | : | 0 - 50 °C |
| 16. | Performance: | | |
| | i. Accuracy | : | ± 0.075% of Span or better |
| | ii. Repeatability | : | ± 0.05% of Span or better |
| 17. | Sealing/Isolation | : | Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications |
| 18. | Accessories | : | <div style="margin-left: 20px;"> a. Universal mounting bracket suitable for 2" pipe mounting

 b. High tensile carbon steel U-bolts </div> |

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

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

1.03.00 Displacer Type Level Transmitters

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

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

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

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

1.05.00 RADAR TYPE LEVEL MEASUREMENT

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

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

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

1.07.00 ULTRASONIC FLOW TRANSMITTER

- | | | | | | | | |
|--|---|---|------------------------|----------------------|---------------------|-----------------------------------|-----------------|
| 1. Type | : | Ultrasonic – Clamp On | | | | | |
| 2. Accuracy | : | +/- 1 % of reading | | | | | |
| 3. Repeatability | : | +/- 0.3 % of reading | | | | | |
| 4. Rangeability | : | 400 : 1 | | | | | |
| 5. Output Signal | : | 4-20 mA DC with HART | | | | | |
| 6. Measured Parameter | : | Volumetric flow, Totalized flow and flow Velocity | | | | | |
| 7. Display | : | LCD with internal Key Pad (Flow rate & Totalization) | | | | | |
| 8. Power Supply | : | 24 V DC (2 Wire) | | | | | |
| 9. Enclosure | : | SS (IP- 68 – Submersible) | | | | | |
| 10. Mounting | : | SS Chain or Strap | | | | | |
| 11. Accessories | | <table border="0"> <tr> <td>1. Handheld calibrator</td> </tr> <tr> <td>2. ½"NPT cable gland</td> </tr> <tr> <td>3. Transducer cable</td> </tr> <tr> <td>4. All mounting hardware (SS-316)</td> </tr> <tr> <td>5. SS Nameplate</td> </tr> </table> | 1. Handheld calibrator | 2. ½"NPT cable gland | 3. Transducer cable | 4. All mounting hardware (SS-316) | 5. SS Nameplate |
| 1. Handheld calibrator | | | | | | | |
| 2. ½"NPT cable gland | | | | | | | |
| 3. Transducer cable | | | | | | | |
| 4. All mounting hardware (SS-316) | | | | | | | |
| 5. SS Nameplate | | | | | | | |
| 12. Adjustment/Calibration/ /Maintenance | : | From handheld calibrator/ HART management system | | | | | |
| 13. Applications | : | Plant water service | | | | | |

Note: Multi-path insertion type (minimum 4 path) Ultrasonic Flow meter shall

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

then separate hand held calibrator will be provided.

3.00.00 PROCESS ACTUATED SWITCHES

3.01.00 PRESSURE SWITCH

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

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

3.02.00 DIFFERENTIAL PRESSURE SWITCH

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

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

approval

3.03.00 LEVEL SWITCH

3.03.01 FLOAT OPERATED

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

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

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

3.04.00 FLOW SWITCH

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

3.05.00 RF LEVEL SWITCH

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

3.06.00 CONDUCTIVITY TYPE LEVEL SWITCH

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

-
- | | | | |
|-----|----------------------|---|---|
| 6. | Input Supply Voltage | : | 240V AC $\pm 10\%$, 50 Hz.
Four independent channel with |
| 7. | Input | : | selectable switching threshold for water conductivity |
| 8. | Relay Output | : | 2 SPDT (240V AC, 5A) |
| 9. | Ambient Temperature | : | 50 °C |
| 10. | Enclosure Protection | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area) |
| 11. | Enclosure Housing | : | SS
HI,LO, HIGH-HIGH, LOW-LOW |
| 12. | Local LED Indication | : | Power
Fault |
| 13. | Accessories | : | <ul style="list-style-type: none"> a) Interconnecting cable from probe to electronics b) Mounting accessories c) External cage d) Washer & Gasket e) $\frac{1}{2}$" NPT Cable Glands f) SS Tag Plate |
| 14. | Application | : | During Detail Engineering on Owner's approval |

3.07.00 TEMPERATURE SWITCH

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

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

approval

4.00.00 **LOCAL INSTRUMENTS**

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

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

		for corrosive/ viscous/ solid bearing or slurry type fluid applications
	c)	3-Way SS316 Gauge cock for pressure gauges
		5-valve SS316 manifold from
	d)	barstock for differential pressure gauge
	e)	Siphons for steam and hot water services
17. Nameplate	:	Tag number, service engraved in stainless steel tag plate
4.02.00	LEVEL INDICATOR (FLOAT & BOARD TYPE)	
1. Type	:	Float and Board
2. Float Material	:	SS-316
3. Float Cable	:	SS-316
4. Indicator Assembly	:	Epoxy painted Aluminium
5. Guide wire spring assembly	:	SS-316 (2 Nos.)
6. Guide Wire Anchor	:	SS-316
		Anodized Aluminium with engraved marking (Minimum graduation 10mm),
7. Scale Board	:	mounting brackets and suitable hardware required as per tank height
8. Elbow Assembly	:	Anodized Aluminium
9. Flanges	:	RF , ANSI 150 , SS (3 Nos.)
10. Accuracy	:	± 10 mm or better
11. Accessories	:	All mounting accessories including counter flange, nuts & bolts, suitable

gasket etc. as applicable, SS Tag plate

4.03.00 GAUGE GLASS

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

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

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

5.00.00 TEMPERATURE ELEMENTS & ACCESSORIES

5.01.00 RESISTANCE TEMPERATURE DETECTOR

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