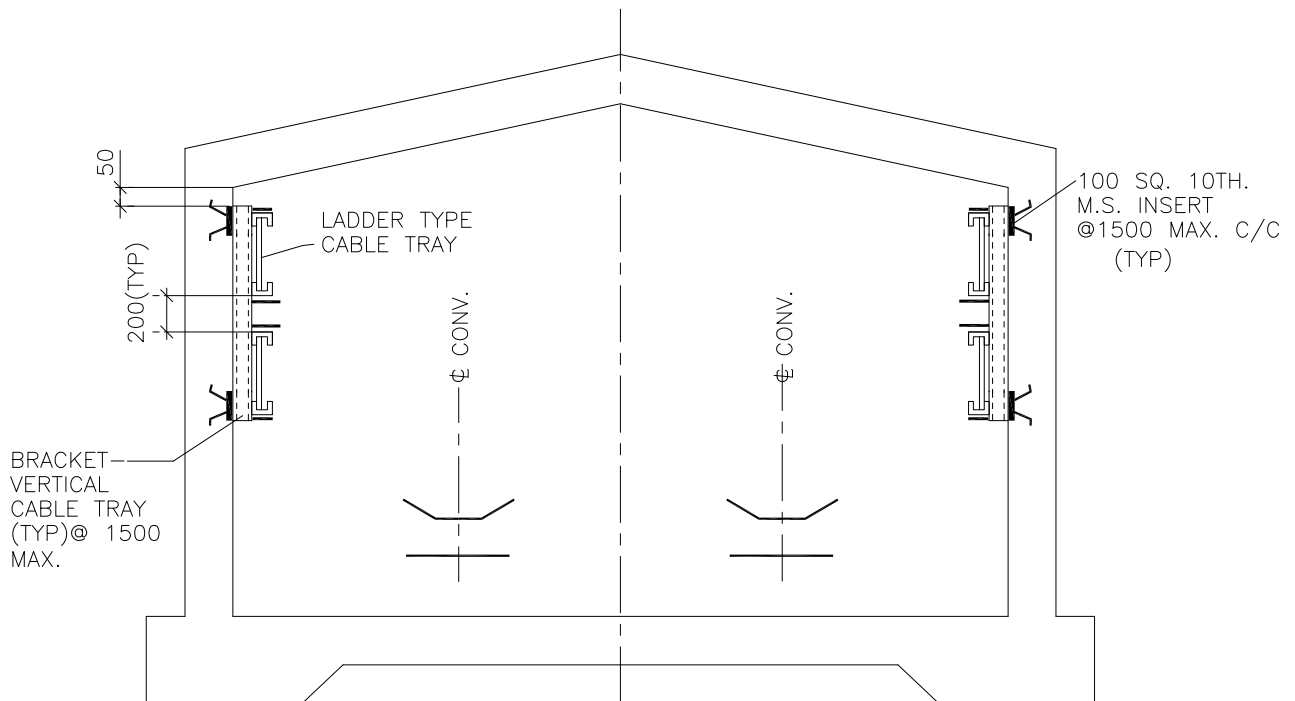
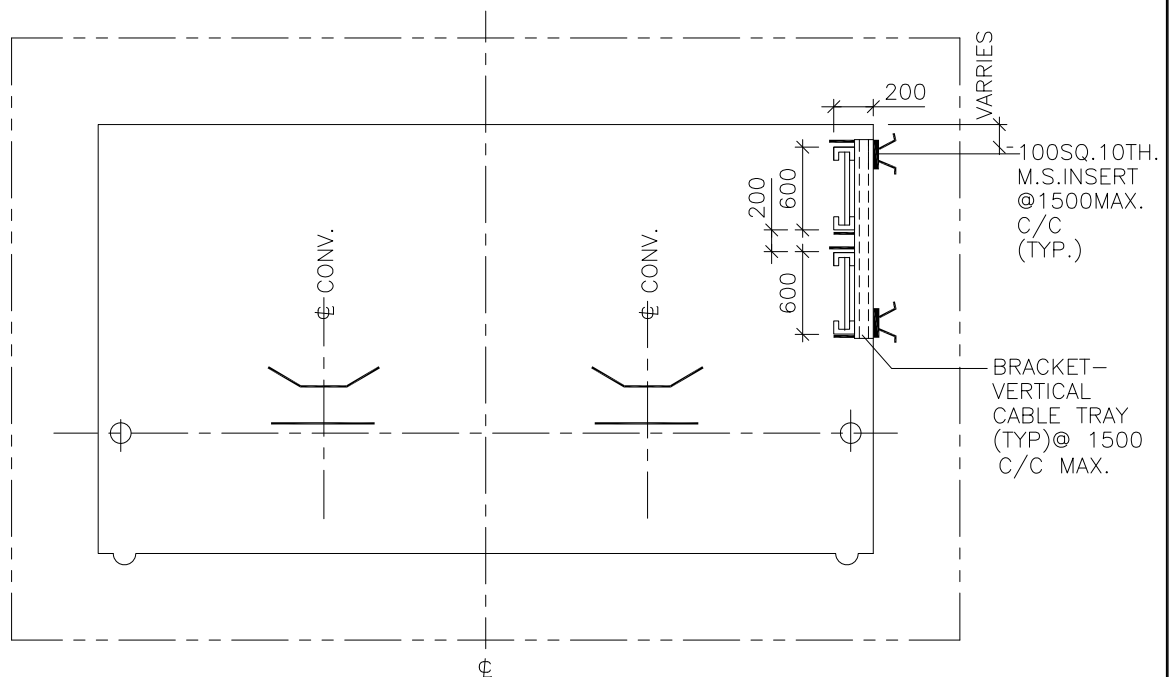




**MOUNTING ARRANGEMENT**  
(IN CONVEYOR TUNNEL-ALT-I)



**MOUNTING ARRANGEMENT**  
(IN CONVEYOR TUNNEL-ALT-II)

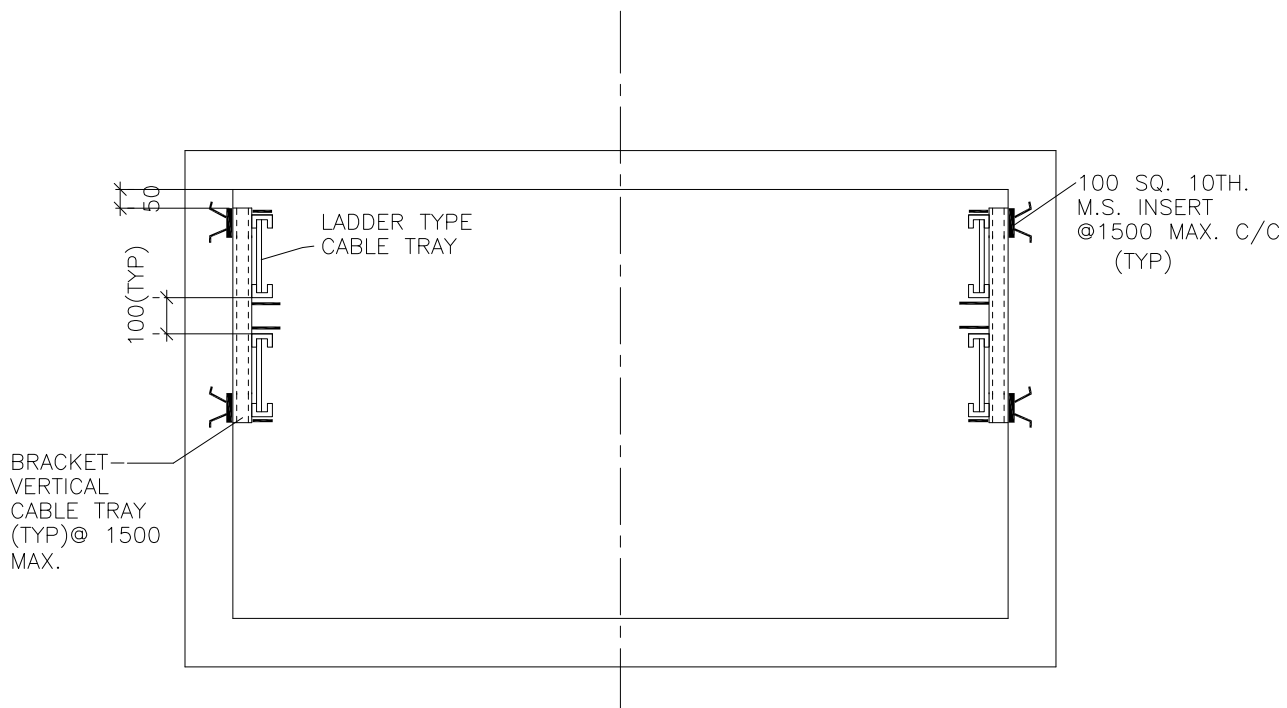
NOTE:-

ALL DIMENSIONS ARE IN MM.

TYPICAL DETAILS OF CABLE TRAY  
SUPPORT SYSTEM

DWG. NO.  
PE-DG-417-507-E006  
REV. 05 SHT. 13 OF 15





TYPICAL VERTICAL ARRANGEMENT

NOTE:—

ALL DIMENSIONS ARE IN MM.



TYPICAL DETAILS OF CABLE TRAY  
SUPPORT SYSTEM

DWG. NO.  
PE-DG-417-507-E006  
REV. 05 SHT. 14 OF 15

NOTES:—

1. ALL DIMENSIONS SHOWN ARE IN MM.
2. CABLE TRAYS SHALL BE SUPPORTED @ 1.5M FOR HORIZONTAL RUNS & @ 1M FOR VERTICAL RUNS (E.G. RISERS).
3. CABLE TRAYS SUPPORTING STRUCTURE SHALL BE FABRICATED AT SITE OUT OF HOT-DIP GALVANISED STRUCTURAL MEMBERS (ISMC/ISA) AS PER REQUIREMENT. AND SHALL BE WELDED TO STRUCTURAL STEEL(WHERE AVAILABLE), OR INSERT PLATES PROVIDED ALONG FLOOR SURFACES/WALLS/BOTTOM OF CEILING.
4. MINIMUM DEPTH REQUIREMENTS FOR TRENCHES ARE INDICATED. SLOPE DETAILS SHALL BE TAKEN CARE OF IN CIVIL DRAWING.
5. CABLE TRENCH TYPES SHALL BE AS UNDER:—
  - a)TYPE-A — SINGLE TRAY, SINGLE SIDE
  - b)TYPE-B — DOUBLE TRAYS, SINGLE SIDE
  - c)TYPE-BB — DOUBLE TRAYS, BOTH SIDES
6. GALVANISATION DAMAGED DUE TO WELDING SHALL BE MADE GOOD WITH APPLICATION (2COATS) OF COLD GALVANISING ANTI CORROSIVE PAINT.
7. NUMBER OF TIERS ARE VARIABLE AS PER THE REQUIREMENT & SHALL BE SHOWN IN RESPECTIVE CABLING LAYOUT DRAWINGS.
8. CABLE TRAYS SHALL GENERALLY BE INSTALLED IN HORIZONTAL ORIENTATION. IN AREAS SUSCEPTIBLE TO COAL/ASH DUST DEPOSITION (E.G OVERHEAD CABLING PATHS IN BOILER AREA, TRAYS BELOW BOILER PLATFORMS ETC.) CABLE TRAYS SHALL BE INSTALLED IN VERTICAL ORIENTATION.
9. PERFORATED TYPE HOT ROLLED MILD SHEET OF 14 GAUGE (2MM THICK) COVERS SHALL BE USED FOR VERTICAL CABLE SHAFTS UPTO A HEIGHT OF 2.5 METERS FROM FLOOR LEVEL.
10. FOR CABLING NOTES AND DETAILS REFER DRAWING NO.PE-DC-417-507-E004\_R3
11. ALL STEEL MATERIAL IS GALVANISED. 
12. FIRE STOP ARRANGEMENT AND DRAWING ARE DEPENDENT ON VENDOR DRAWING /DOCUMENT. IT SHALL BE INDICATED IN FIRE SEALING VENDOR DRAWING..







TYPICAL DETAILS OF CABLE TRAY  
SUPPORT SYSTEM

DWG. NO.  
PE-DG-417-507-E006

REV. 05 SHT. 15 OF 15



**TECHNICAL SPECIFICATION  
FOR AIR CONDITIONING SYSTEM  
5X800 MW YADADRI TPS**

DOCUMENT NO.: PE-TS-417-553-A001

REVISION 00

DATE: JUN 2020

**SECTION: I  
SUB-SECTION: C4  
TECHNICAL SPECIFICATION (C&I PORTION)**





Technical specification for  
**CONTROL & INSTRUMENTATION**  
5x800 MW YADADRI TPS, NALGONDA

SPEC NO.: **PE-TS-417-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 02.07.2020

SHEET OF

**C&I SPECIFICATION  
FOR  
AIR CONDITIONING (AC) SYSTEM**

|                                                                                   |                                                                                                                                                                    |                                  |                   |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------|
|  | <b>5X800 MW YADADRI TPS, NALGONDA</b><br><br><b>CONTROL &amp; INSTRUMENTATION</b><br><br><b>Technical specification for</b><br><b>AIR CONDITIONING (AC) SYSTEM</b> | SPEC NO.: <b>PE-TS-417-145-I</b> |                   |
|                                                                                   |                                                                                                                                                                    | VOLUME                           |                   |
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|  | <b>5X800 MW YADADRI TPS, NALGONDA</b><br><br><b>CONTROL &amp; INSTRUMENTATION</b><br><br><b>Technical specification for</b><br><b>AIR CONDITIONING (AC) SYSTEM</b> | SPEC NO.: <b>PE-TS-417-145-I</b> |                   |
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CONFIGURATION DRAWING, QUALITY PLAN
7. ERECTION HARDWARE
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9. LCP AND JUNCTION BOX SPECIFICATION WITH QUALITY  
PLAN
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|  | <p>Technical specification for<br/><b>CONTROL &amp; INSTRUMENTATION</b><br/>5x800 MW YADADRI TPS, NALGONDA</p> | SPEC NO.: <b>PE-TS-417-145-I</b> |                   |
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## SPECIFIC TECHNICAL REQUIREMENT



Specific Technical Requirement

**AIR CONDITIONING PLANT**

5X800 MW  
YADADRI TPS, NALGONDA

1. **The bidder shall provide complete Instrumentation, control system for control, monitoring and operation of Air Conditioning Plant.** The requirements given are to be read in conjunction with detailed Technical specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre bid clarification. In absence of any pre bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial and time implication.

2. **Air Conditioning Plant along with ventilation system (through separate contract)** shall be operated & controlled from common stage-wise PLC based control system with interface with plant DCS. Operation & Control of HVAC plant is envisaged through PLC/RIO's panels mentioned below which are placed at different locations.:

**Stage # 1**

- Stage I (Unit 1 & 2) PLC panel to be placed in Stage # I - AC plant control room located at ground floor of CCR/CER (Unit # 1 & 2).
- Stage I (Unit 1 & 2) RIO panel to be placed in FGD Stage I Control Room. This
- RIO panel will be hooked up with stage I PLC panel.

**Stage # 2**

- Stage II (Unit 3, 4 & 5) PLC panel to be placed in Stage # 2 - AC plant control room located at ground floor of CCR/CER (Unit # 3 & 4).
- Stage II (Unit 3, 4 & 5) RIO panel to be placed in FGD Stage II Control Room.
- This RIO panel will be hooked up with stage II PLC panel.

**Common RIO's to be hooked up with both PLC's i.e., stage I & stage II PLC panels**

- Common RIO panel to be placed in Switchyard control room and hooked up with both stagewise PLC's.
- Common RIO panel to be placed in DM Plant Control room and hooked up with both stagewise PLC's.

**Tentative I/O's count for Ventilation system (AHU and UAF's) is annexed.**

3. A common, stagewise PLC based control system cum Annunciation panel with solid state annunciation windows along with product integrated microprocessor panel for the chilling unit shall be provided for the operation of Air Conditioning and Ventilation system by the AC system vendor.
4. PLC shall have redundancy at processor (HOT STANDBY), power supply, communication system.
5. PLC shall have the facility to synchronize its time with BHEL supplied GPS. Necessary Hardware (IRIG-B port) for same at PLC end to be provided by bidder. The cable connecting PLC and GPS shall be in BHEL scope.
6. Redundant PLC communication shall be provided for communication between PLC and DCS through serial link with OPC Compliant for monitoring /Control. For detail, please



Specific Technical Requirement

**AIR CONDITIONING PLANT**

5X800 MW  
YADADRI TPS, NALGONDA

refer PLC Architecture Diagram. Separate OPC servers with required hardware/software to interface with main plant DCS shall be provided.

**7. Following is the HMI requirement**

- 1 no. OWS to be placed in main control room CCR1
- 1 no. OWS to be placed in main control room CCR2
- 1 no. OWS to be placed in main control room CCR3
- 2 no. OWS, 1 no. OEWS and 1 no. A3/A4 printer to be placed in local control room (LCR) stage #1
- 2 no. OWS, 1 no. OEWS and 1 no. A3/A4 printer to be placed in local control room (LCR) stage # 2
- 1 no. OEWS to be placed in FGD 1 control room.
- 1 no. OEWS to be placed in FGD 2 control room.
- 1 no. OEWS to be placed in Switchyard control room.
- 1 no. OEWS to be placed in DM Plant control room.
- 1 no. Laptop for each Stage PLC.

**8. Redundancy of sensors shall be provided, irrespective of instrumentation shown in the PID, by bidder as per following:**

- (i) Triple redundancy for all analog and binary inputs required for protection of system /drives.
- (ii) For all other control functions & alarms, dual redundancy of the sensors shall be provided by the bidder.

**9. Supplied system shall provide group alarms to be hardwired to plant DCS. Same shall be discussed during detail engineering.**

**10. Redundant Uninterrupted Power Supplies (UPS) with adequate rating of continuous duty with backup shall be provided for the stage wise PLC system. Redundant non-UPS supply feeder 415 V, 3 phase, AC supply shall be provided by BHEL based on the load data provided by the bidder. Power supply requirement of PLC RIO panels at FGD control rooms shall be fed from stage wise UPS while PLC RIO panel at switchyard and DM plant shall be fed from both stage wise UPS.**

UPS is in bidder's scope and shall be in line with the specifications of main plant UPS.

**11. The quantity of instruments for the system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.**

**12. All the instruments shall be supplied along with necessary fittings, accessories, valve manifold, root valves, Junction box, Canopy & Structural steel as required. Instrument Installation along with hardware shall be in bidder scope. Double root valves shall be provided where pressure is above 40 Kg/cm<sup>2</sup>.**



Specific Technical Requirement

**AIR CONDITIONING PLANT**

5X800 MW  
YADADRI TPS, NALGONDA

- 13.** The solenoid operated valves/ damper/gates shall have limit switches for open/ close feedback. Solenoid valve shall be rated for 24 V DC only.
- 14.** The junction boxes/LIEs for termination of instruments /solenoid valve limit switches etc. are in bidder's scope. All instruments shall be terminated on JB/LCP in field and both instrument and JB/LCP are in bidder scope.
- 15.** Enclosure class of all transmitters & electronics items including JB's shall be explosion proof.
- 16.** 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 or repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- 17.** All necessary instruments such as transmitters/temperature elements/sensors/switches/gauges etc. shall be provided for safe, efficient & reliable operation and maintenance of the air conditioning plant.
- 18.** Transmitters shall be provided instead of switches.
- 19.** All Instruments must have separate tapping lines. Sharing of the same tapping pipe for redundant instruments or various different instruments is not acceptable.
- 20.** As a general rule, measuring points and measuring equipment for critical protection shall be separate from and not combined with measuring equipment for the automatic control equipment.
- 21.** 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.
- 22.** Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
- 23.** Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.
- 24.** 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.



Specific Technical Requirement

**AIR CONDITIONING PLANT**

5X800 MW  
YADADRI TPS, NALGONDA

25. 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.
26. Each valve/instrument shall be fitted with a stainless steel or aluminum nameplate indicating the valve/instrument service and reference number in accordance with the approved equipment coding system.
27. The equipment shall be of modern, compact design incorporating the latest developments in proven technology.
28. Solenoid valves shall be kept in pneumatic junction boxes only. Air distribution for SOV's shall be through SS manifold with SS isolation valves and auto drain traps and SS tubing from SOV to valves shall not be more than 6 meters.
29. All furniture (tables, chairs etc.) required for PLC operator HMI shall be in bidder's scope. Chairs shall be capable of being adjusted for height and position of backrest. One table and chair shall be provided for each operator station and separate table for each printer.
30. Electronic instruments shall not be located close to hot lines, vessels or other hot equipment. Ambient temperatures exceeding 80 °C shall not result in calibration difficulties or rapid deterioration of electronic components.
31. All the instruments/equipment/electrical items shall be provided & designed with maximum star rating in line with energy conservation policies as per latest international standards at the time of supply.
32. Bidder to provide erection hardware including canopies, structural steel as required.
33. Bidder to perform tests of C&I items/instruments/systems as per quality plans/type test attached in the specification.
34. Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
35. Each valve/instrument shall be fitted with a stainless steel or aluminium nameplate indicating the valve/instrument service and reference number in accordance with the approved equipment coding system.
36. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.
37. Mandatory spares have to be supplied by bidder as mentioned in the specification.





Specific Technical Requirement

**AIR CONDITIONING PLANT**

5X800 MW  
YADADRI TPS, NALGONDA

**38.** The specifications for instruments mentioned in the specification are minimum requirements. Datasheets of instrument shall be subject to customer/owner approval.

**39.** Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract:

- Local Control room drawing
- GA & wiring diagram of local panel.
- PLC configuration diagram.
- Local control panel & instruments data sheet.
- Control & operational write-up for the system
- Control scheme/ logic diagram
- List of Drives (Solenoid valves etc.)
- I/O list
- Power requirement.
- JB grouping document.
- Cable schedule and cable interconnection drawing.
- Instrument schedule
- Alarm Schedule
- SOE schedule
- Instrument hook-up diagram.
- Mandatory spare BOQ
- UPS load list
- Any other document decided during detailed engineering.

**Notes:**

1. All equipment items shall be of latest design with proven on track record from reputed experienced manufacturers of specified type and range of equipment. The make/model of various instruments/items/systems and instrument sub-vendor shall be subject to approval of BHEL/Customer during detailed engineering stage.
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. Uniformity of make and type of instruments and control components shall be followed throughout for rationalization of spares' inventory, except for certain proprietary items where this requirement cannot be met.



Specific Technical Requirement

**AIR CONDITIONING PLANT**

5X800 MW  
YADADRI TPS, NALGONDA

## IO COUNTS FOR VENTILATION SYSTEM

|                  | Ventilation |    | Ventilation (drive) |     |     |
|------------------|-------------|----|---------------------|-----|-----|
| <b>STAGE#1</b>   | DI          | AI | DI                  | DO  | AI  |
| Main Power House | 90          | 20 | 330                 | 180 | 85  |
| Service Building | 0           | 0  | 0                   | 0   | 0   |
| ESP Building #1  | 20          | 5  | 160                 | 60  | 35  |
| ESP Building #2  | 20          | 5  | 160                 | 60  | 35  |
| FGD Building     | 20          | 5  | 160                 | 60  | 35  |
| <b>STAGE#2</b>   |             |    |                     |     |     |
| Main Power House | 150         | 30 | 550                 | 220 | 120 |
| Service Building | 0           | 0  | 0                   | 0   | 0   |
| ESP Building #3  | 20          | 5  | 160                 | 60  | 35  |
| ESP Building #4  | 20          | 5  | 160                 | 60  | 35  |
| ESP Building #5  | 20          | 5  | 160                 | 60  | 35  |
| FGD Building     | 20          | 5  | 160                 | 60  | 35  |
| <b>COMMON</b>    |             |    |                     |     |     |
| DM Plant         | 0           | 0  | 0                   | 0   | 0   |

**Note:** The above list of IO counts is for ventilation system and for estimation purpose only. The final IO count may vary in the range of +/- 20 %. Additional IO's if required for the ventilation system shall be provided by the successful bidder without any cost and delivery implication to BHEL. The spares IO shall be considered separately in line with the requirement of technical specification.

The IO's for the AC system shall be derived by the bidder inline with the requirements of the technical specification.



Technical specification for  
**CONTROL & INSTRUMENTATION**  
 5x800 MW YADADRI TPS, NALGONDA

SPEC NO.: **PE-TS-417-145-I**

VOLUME

SECTION

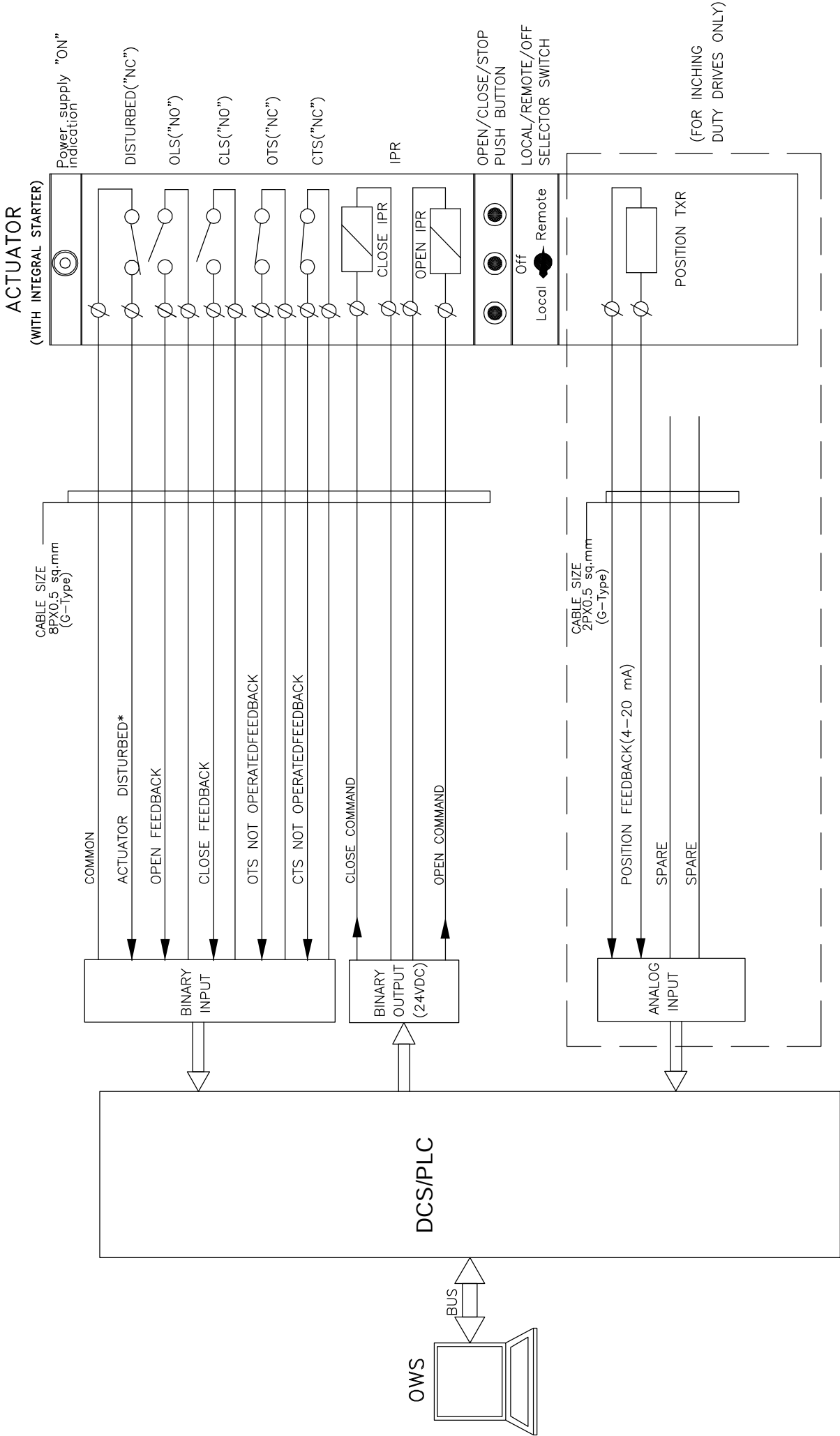
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SHEET OF

## Drive Control Philosophy

DCS INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)



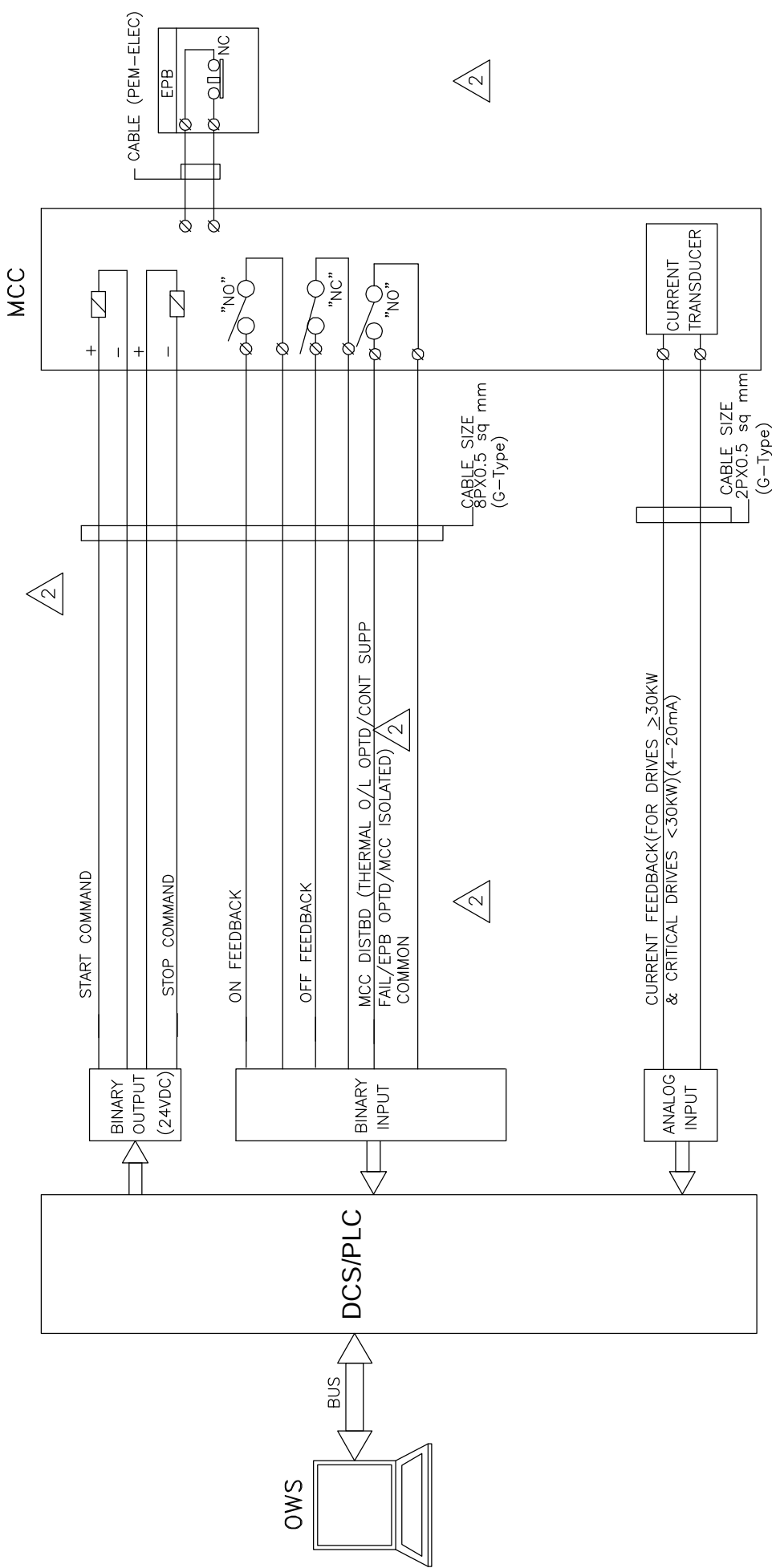
NOTE:

- \* DISTURBED= Loss of Power supply (1 Phase/3 Phase)/ Loss of control supply/ Motor thermostat trip/ Thermal over load/Torque open/close cutoff Local/Off/Remote Sel. switch Stop PB optd.

|  |          |                                         |  |
|--|----------|-----------------------------------------|--|
|  | PROJECT: | 5X800 YADADRI THERMAL POWER STATION     |  |
|  | TITLE:   | UNIT # 1 TO 5                           |  |
|  |          | DDCMS INTERFACE FOR BIDIRECTIONAL DRIVE |  |

|         |                    |
|---------|--------------------|
| DRG.NO. | PE-DM-417-145-1002 |
| DATE    | 06.12.2019         |
| REV.NO. | 03                 |
| SHT     | 7 OF 11            |

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



NOTE:-

1) EPB OF RESPECTIVE DRIVE WILL BE MOUNTED NEAR TO DRIVE ONLY.

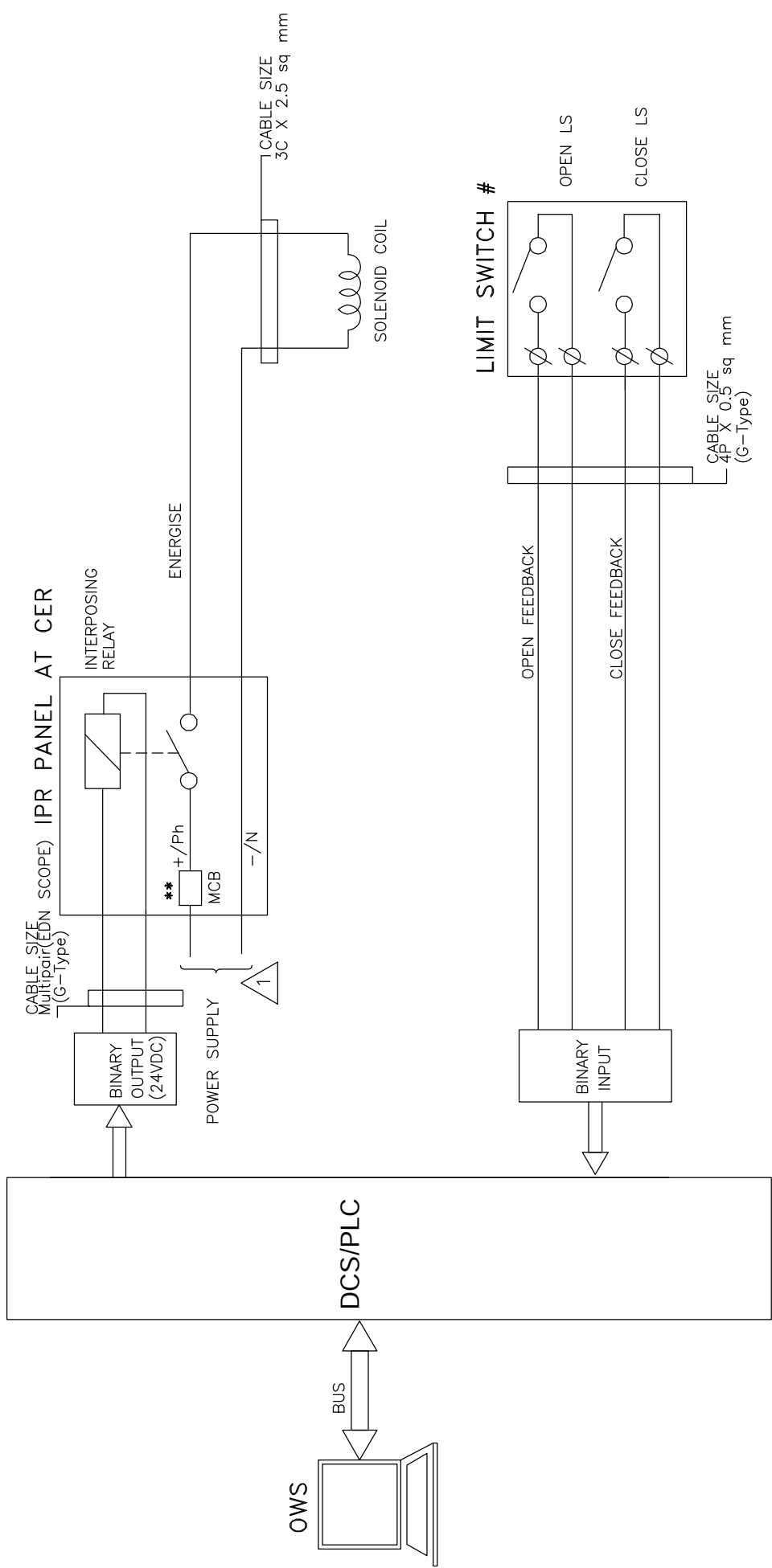
2) 4-20mA CURRENT TRANSDUCER SHALL BE CONSIDERED. FOR LTUDs >30 KW AND IMPORTANT DRIVES, LUBE OIL PUMPS (REFER CLAUSE D, SHEET 6 OF 11)

1

2

|                                                                                       |          |                                              |         |                    |
|---------------------------------------------------------------------------------------|----------|----------------------------------------------|---------|--------------------|
|  | PROJECT: | 5X800 YADADRI THERMAL POWER STATION          | DRG.NO. | PE-DM-417-145-1002 |
|                                                                                       | TITLE:   | DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE | DATE    | 06.12.2019         |
|                                                                                       |          |                                              | REV.NO. | 03                 |
|                                                                                       |          |                                              | SHT     | 8 OF 11            |

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

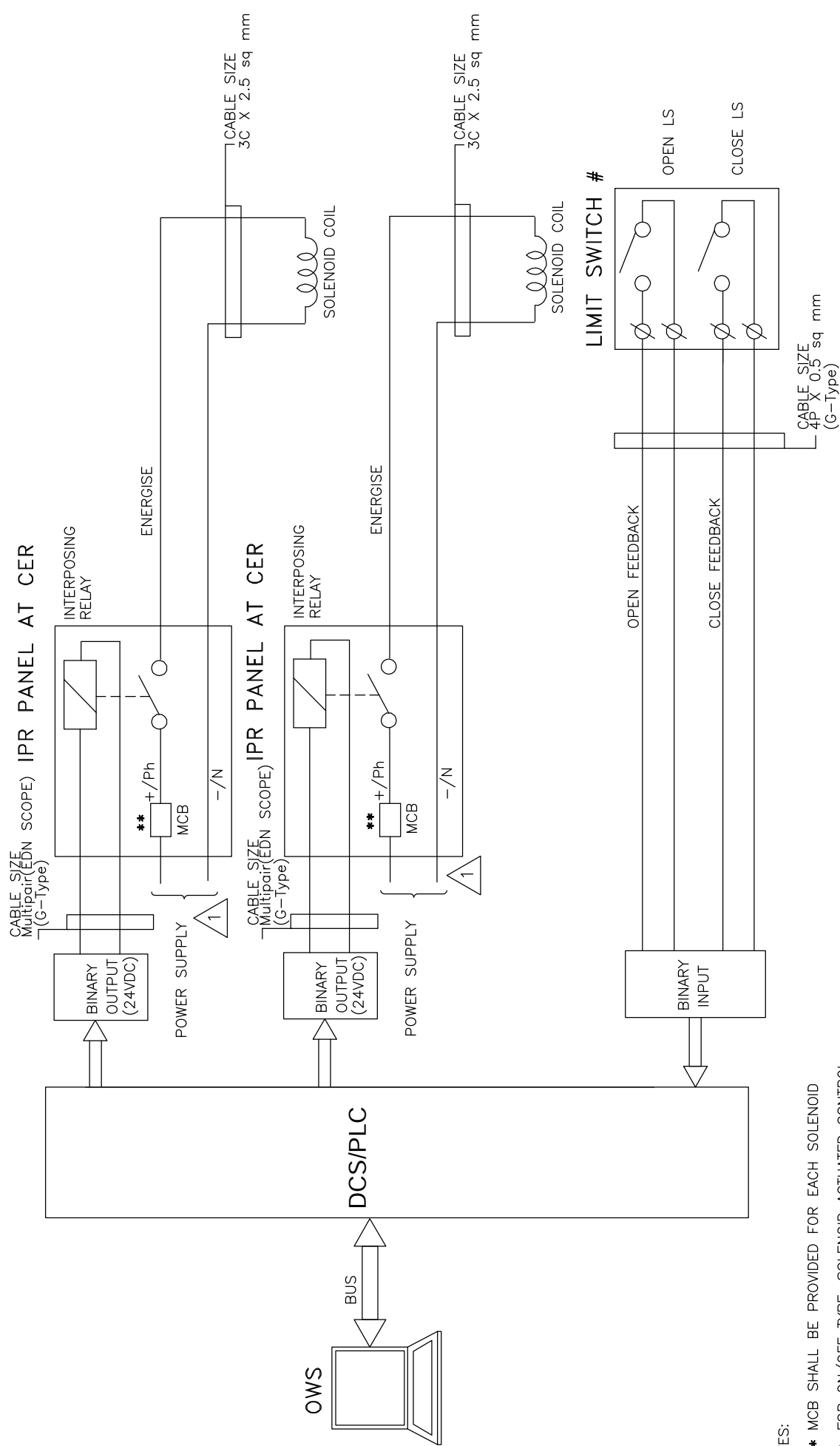


NOTES:

- \*\* MCB SHALL BE PROVIDED FOR EACH SOLENOID
- # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

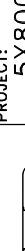
|  |          |                                                      |      |            |
|--|----------|------------------------------------------------------|------|------------|
|  | PROJECT: | 5X800 YADADRI THERMAL POWER STATION<br>UNIT # 1 TO 5 |      |            |
|  | TITLE:   | DDCMIS INTERFACE FOR<br>SOLENOID DRIVE (SINGLE COIL) |      |            |
|  | DRG.NO.  | PE-DM-417-145-1002                                   | DATE | 06.12.2019 |
|  | REV.NO.  | 03                                                   | SHT  | 9 OF 11    |

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



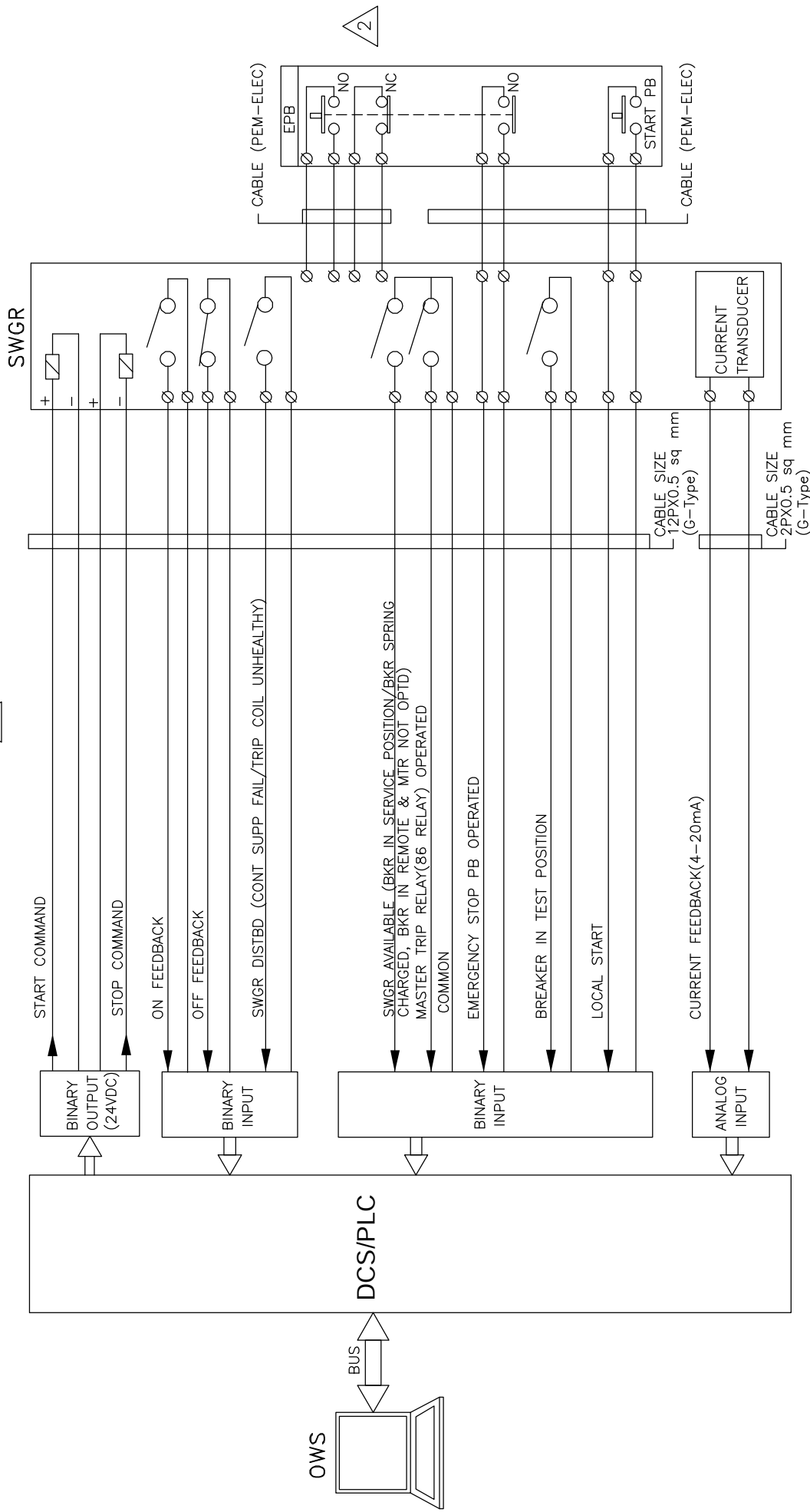
NOTES:

- \*\* MCB SHALL BE PROVIDED FOR EACH SOLENOID
- # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

|                                                                                      |          |                                     |  |         |                    |
|--------------------------------------------------------------------------------------|----------|-------------------------------------|--|---------|--------------------|
|  | PROJECT: | 5X800 YADADRI THERMAL POWER STATION |  | DRG.NO. | PE-DM-417-145-1002 |
|                                                                                      |          | UNIT # 1 TO 5                       |  | DATE    | 06.12.2019         |
|                                                                                      | TITLE:   | DDCMIS INTERFACE FOR                |  | REV.NO. | 03                 |
|                                                                                      |          | SOLENOID DRIVE (DOUBLE COIL)        |  | SHT     | 9a OF 11           |

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

2



NOTE:-  
EPB OF RESPECTIVE DRIVE WILL BE MOUNTED NEAR TO DRIVE ONLY.



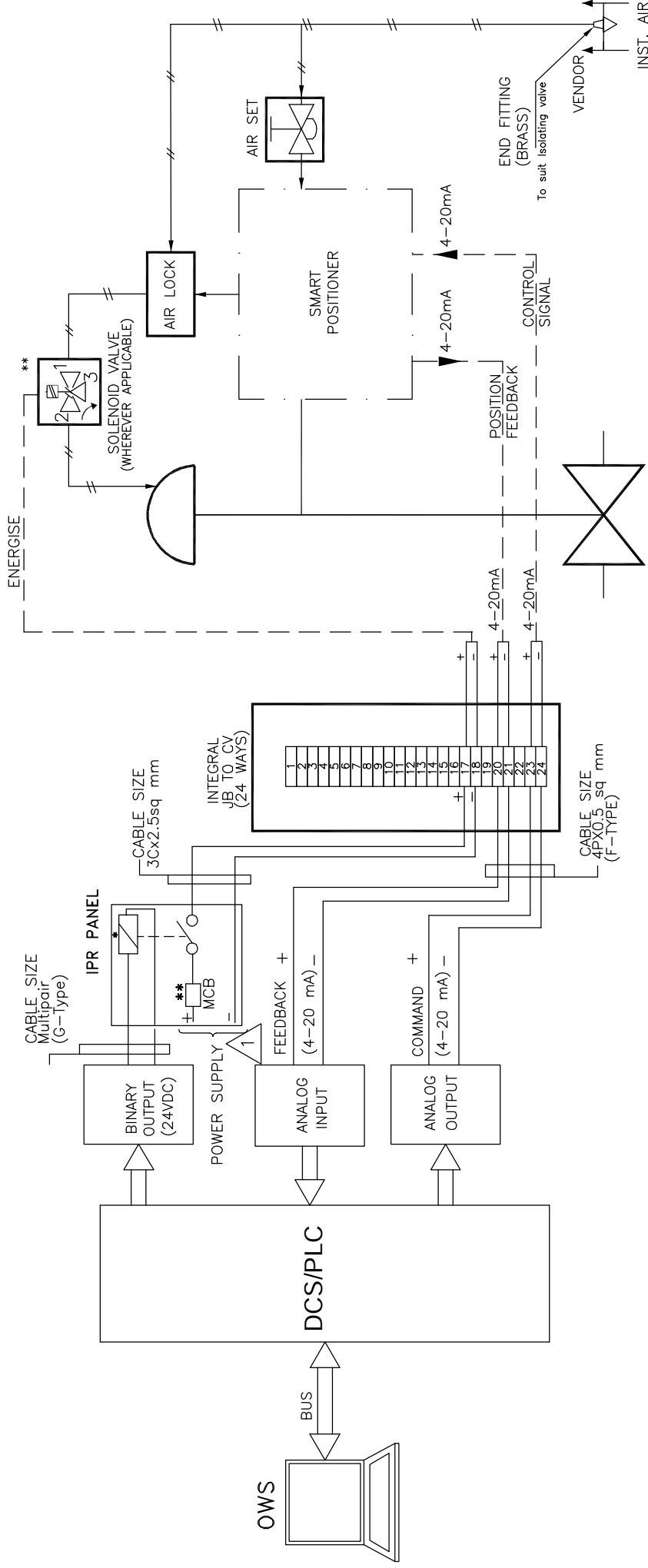
PROJECT: 5X800 YADADRI THERMAL POWER STATION  
UNIT # 1 TO 5  
TITLE: DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE

|         |                    |
|---------|--------------------|
| DRG.NO. | PE-DM-417-145-1002 |
| DATE    | 06.12.2019         |
| REV.NO. | 03                 |
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1



DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

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

|                                                                                       |          |                                                                 |         |                    |
|---------------------------------------------------------------------------------------|----------|-----------------------------------------------------------------|---------|--------------------|
|  | PROJECT: | 5X800 YADADRI THERMAL POWER STATION<br>UNIT # 1 TO 5            | DRG.NO. | PE-DM-417-145-1002 |
|                                                                                       | TITLE:   | TYPICAL HOOK-UP DIAGRAM<br>ANALOG DRIVE (WITH SMART POSITIONER) | DATE    | 06.12.2019         |
|                                                                                       |          |                                                                 | REV.NO. | 03                 |
|                                                                                       |          |                                                                 | SHT     | 11 OF 11           |



Technical specification for  
**CONTROL & INSTRUMENTATION**  
 5x800 MW YADADRI TPS, NALGONDA

SPEC NO.: **PE-TS-417-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 02.07.2020

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



Technical specification for  
**CONTROL & INSTRUMENTATION**  
 5x800 MW YADADRI TPS, NALGONDA

SPEC NO.: **PE-TS-417-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 03.04.2018

SHEET OF

# Actuator Data Sheet



|                                                                                   |                                                                |                                                                                                                                                                                                                                                                                                  |                                             |                 |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------|
|  | <b>SPECIFICATION<br/>FOR<br/>MOTORISED VALVE ACTUATOR</b>      |                                                                                                                                                                                                                                                                                                  | DOCUMENT NO. : PE-ID-417-145-I902           |                 |
|                                                                                   |                                                                |                                                                                                                                                                                                                                                                                                  | VOLUME II B                                 |                 |
|                                                                                   |                                                                |                                                                                                                                                                                                                                                                                                  | SECTION D                                   |                 |
|                                                                                   |                                                                |                                                                                                                                                                                                                                                                                                  | REV. NO. 00                                 | DATE:15/05/2019 |
|                                                                                   |                                                                |                                                                                                                                                                                                                                                                                                  | SHEET 1                                     | OF 4            |
| <b>Data Sheet A &amp; B</b>                                                       |                                                                |                                                                                                                                                                                                                                                                                                  |                                             |                 |
| DATA SHEET-A<br>(TO BE FILLED BY PURCHASER)                                       |                                                                |                                                                                                                                                                                                                                                                                                  | DATA SHEET-B<br>(TO BE FILLED-UP BY BIDDER) |                 |
| <b>GENERAL *</b>                                                                  | * PROJECT                                                      | 5 X 800 MW YADADRI TPS, NALGONDA                                                                                                                                                                                                                                                                 |                                             |                 |
|                                                                                   | OFFER REFERENCE                                                |                                                                                                                                                                                                                                                                                                  |                                             |                 |
|                                                                                   | * TAG NO. SERVICE                                              |                                                                                                                                                                                                                                                                                                  |                                             |                 |
|                                                                                   | * DUTY                                                         | <input type="checkbox"/> ON / OFF ** <input type="checkbox"/> INCHING                                                                                                                                                                                                                            |                                             |                 |
|                                                                                   | * LINE SIZE (inlet/outlet): MATERIAL                           |                                                                                                                                                                                                                                                                                                  |                                             |                 |
|                                                                                   | * VALVE TYPE                                                   | <input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE<br><input type="checkbox"/> 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                                                                                                                                                                                                                                                                                |                                             |                 |
|                                                                                   | <b>CONSTRUCTION AND SIZING</b>                                 | CONSTRUCTION                                                                                                                                                                                                                                                                                     | TOTALLY ENCLOSED, WEATHER PROOF, IP:68      |                 |
| MECHANICAL POSITION INDICATOR                                                     |                                                                | TO BE PROVIDED FOR 0-100% TRAVEL                                                                                                                                                                                                                                                                 |                                             |                 |
| BEARINGS                                                                          |                                                                | DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.                                                                                                                                                                                                                                                |                                             |                 |
| GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION                               |                                                                | METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.                                                                                                                                                                           |                                             |                 |
| SIZING                                                                            |                                                                | OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. <b>FOR INCHING SERVICE - 150 STARTS/HR MINIMUM &amp; FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.</b> |                                             |                 |
| <b>HANDWHEEL as per standard EN 12570:2000</b>                                    | * REQUIRED                                                     | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO                                                                                                                                                                                                                              |                                             |                 |
|                                                                                   | * ORIENTATION                                                  | <input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED                                                                                                                                                                                                                       |                                             |                 |
|                                                                                   | *TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.            |                                                                                                                                                                                                                                                                                                  |                                             |                 |
| <b>ELECTRIC ACTUATOR</b>                                                          | 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                             | <input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM)<br>DRG. NO. 3-V-MISC-24227 R00                                                                                                                                                                                                  |                                             |                 |
|                                                                                   | COLOUR SHADE                                                   | <input type="checkbox"/> BLUE (RAL 5012) <input type="checkbox"/> .....                                                                                                                                                                                                                          |                                             |                 |
|                                                                                   | PAINT TYPE (## Refer Notes)                                    | <input type="checkbox"/> ENAMEL <input type="checkbox"/> EPOXY CONFIRMING TO CORROSION CATEGORY C5-I                                                                                                                                                                                             |                                             |                 |
|                                                                                   | SHAFT RPM                                                      | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                |                                             |                 |
|                                                                                   | OLR SET VALUE                                                  | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                |                                             |                 |
|                                                                                   | @ STARTING / FULL LOAD CURRENT                                 | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                |                                             |                 |
|                                                                                   | NO. OF REV FOR FULL TRAVEL                                     | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                |                                             |                 |
|                                                                                   | @ PWR SUPP TO MTR / STARTER                                    | 415V, 3PH, AC                                                                                                                                                                                                                                                                                    |                                             |                 |
|                                                                                   | @ CONTROL VOLTAGE REQUIREMENT                                  | TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input type="checkbox"/> 110 V                                                                                                                                                                                 |                                             |                 |
|                                                                                   | @ ENCLOSURE CLASS OF MOTOR                                     | <input type="checkbox"/> IP 67 <input type="checkbox"/> IP 68 <input type="checkbox"/> FLAME PROOF                                                                                                                                                                                               |                                             |                 |
|                                                                                   | @ INSULATION CLASS                                             | CLASS-F TEMP. RISE LIMITED TO CLASS-B                                                                                                                                                                                                                                                            |                                             |                 |

|                                                                                                                                                                                       |                                                           |                                                                                                                                                        |                                   |                                                                             |   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------------------------------------------------|---|
|                                                                                                                                                                                       | <b>SPECIFICATION<br/>FOR<br/>MOTORISED VALVE ACTUATOR</b> |                                                                                                                                                        | DOCUMENT NO. : PE-ID-417-145-I902 |                                                                             |   |
|                                                                                                                                                                                       |                                                           |                                                                                                                                                        | VOLUME II B                       |                                                                             |   |
|                                                                                                                                                                                       |                                                           |                                                                                                                                                        | SECTION D                         |                                                                             |   |
|                                                                                                                                                                                       |                                                           |                                                                                                                                                        | REV. NO. 00                       | DATE:15/05/2019                                                             |   |
|                                                                                                                                                                                       |                                                           |                                                                                                                                                        | SHEET 2                           | OF                                                                          | 4 |
| <b>Data Sheet A &amp; B</b>                                                                                                                                                           |                                                           |                                                                                                                                                        |                                   |                                                                             |   |
| DATA SHEET-A<br>(TO BE FILLED BY PURCHASER)                                                                                                                                           |                                                           |                                                                                                                                                        |                                   | DATA SHEET-B<br>(TO BE FILLED-UP BY BIDDER)                                 |   |
|                                                                                                                                                                                       | @ WINDING TEMP PROTECTION                                 | <input checked="" type="checkbox"/> THERMOSTAT (3 Nos.,1 IN EACH PHASE)<br><input type="checkbox"/> -----                                              |                                   |                                                                             |   |
|                                                                                                                                                                                       | SINGLE PHASE / WRONG PHASE<br>SEQUENCE PROTECTION         | REQUIRED (THERMISTOR PTC)                                                                                                                              |                                   |                                                                             |   |
| <b>INTEGRAL<br/>STARTER</b>                                                                                                                                                           | INTEGRAL STARTER                                          | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                     |                                   |                                                                             |   |
|                                                                                                                                                                                       | TYPE OF SWITCHING DEVICE                                  | <input type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS                                                                                |                                   |                                                                             |   |
|                                                                                                                                                                                       | TYPE                                                      | <input type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)                                                                   |                                   |                                                                             |   |
|                                                                                                                                                                                       | IF SMART (REFER BELOW POINT a – h )                       |                                                                                                                                                        |                                   |                                                                             |   |
|                                                                                                                                                                                       | a) SERIAL LINK INTERFACE                                  | <input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED                                                                               |                                   |                                                                             |   |
|                                                                                                                                                                                       | b) SERIAL LINK PROTOCOL                                   | <input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS<br><input type="checkbox"/> DEVICE NET <input type="checkbox"/> ..... |                                   |                                                                             |   |
|                                                                                                                                                                                       | c) SERIAL LINK MEDIA                                      | <input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL<br><input type="checkbox"/> OFC                                  |                                   |                                                                             |   |
|                                                                                                                                                                                       | d) HAND HELD PROGRAMMER                                   | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                |                                   |                                                                             |   |
|                                                                                                                                                                                       | e) TYPE OF HAND HELD<br>PROGRAMMER                        | <input type="checkbox"/> BLUETOOTH <input type="checkbox"/> INFRARED <input type="checkbox"/> .....                                                    |                                   |                                                                             |   |
|                                                                                                                                                                                       | f) MASTER STATION                                         | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                |                                   |                                                                             |   |
|                                                                                                                                                                                       | g) MASTER STN INTRFACE WITH DCS                           | <input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP                                                                                        |                                   |                                                                             |   |
|                                                                                                                                                                                       | h) DETAILS OF SPECIAL CABLE                               | <input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED                                                                                |                                   |                                                                             |   |
|                                                                                                                                                                                       | STEP DOWN CONT. TRANSFORMER                               | <input checked="" type="checkbox"/> REQUIRED                                                                                                           |                                   |                                                                             |   |
|                                                                                                                                                                                       | OPEN / CLOSE PB                                           | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                     |                                   |                                                                             |   |
|                                                                                                                                                                                       | STOP PB                                                   | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                     |                                   |                                                                             |   |
|                                                                                                                                                                                       | INDICATING LAMPS                                          | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                     |                                   |                                                                             |   |
|                                                                                                                                                                                       | LOCAL REMOTE S/S                                          | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                     |                                   |                                                                             |   |
|                                                                                                                                                                                       | STATUS CONTACTS FOR MONITORING                            | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                     |                                   |                                                                             |   |
|                                                                                                                                                                                       | INTEGRAL STARTER DISTURBED<br>SIGNAL(Refer Note 14)       | REQUIRED (O/L RELAY OPERATED,<br>CONT./POWER SUPPLY FAILED, S/S IN LOCAL,<br>TORQUE SWITCH OPTD. MID WAY, )                                            |                                   |                                                                             |   |
|                                                                                                                                                                                       | ACTION ON LOSS OF EXTERNAL<br>ELECTRIC POWER              | <input type="checkbox"/> STAYPUT <input type="checkbox"/> FAIL SAFE                                                                                    |                                   |                                                                             |   |
| <b>INTERPOSING<br/>RELAY/OPTO<br/>COUPLER</b><br>(Applicable for<br>integral Starter)<br><b>DATASHEET &amp;<br/>WIRING<br/>DIAGRAM OF<br/>ISOLATION<br/>DEVICE TO BE<br/>PROVIDED</b> | TYPE OF ISOLATING DEVICE                                  | <input checked="" type="checkbox"/> INTERPOSING RELAY <input type="checkbox"/> OPTO COUPLER<br>TO BE DECIDED DURING DETAILED<br>ENGINEERING            |                                   |                                                                             |   |
|                                                                                                                                                                                       | QUANTITY                                                  | <input type="checkbox"/> 2 NOS. <input type="checkbox"/> 3 NOS.                                                                                        |                                   |                                                                             |   |
|                                                                                                                                                                                       | DRIVING VOLTAGE                                           | <input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC                                                                  |                                   |                                                                             |   |
|                                                                                                                                                                                       | DRIVING CURRENT                                           | <input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX                                                                    |                                   |                                                                             |   |
|                                                                                                                                                                                       | LOAD RESISTANCE                                           | <input checked="" type="checkbox"/> > 192 ohms - <25 k ohms<br><input type="checkbox"/> > _____ ohms - < _____ ohms                                    |                                   |                                                                             |   |
| <b>TORQUE<br/>SWITCH</b><br>(Not Applicable<br>for Smart<br>Actuator)<br><b>(\$\$ Refer<br/>Notes)</b>                                                                                | MFR & MODEL NO.                                           | BIDDER TO SPECIFY                                                                                                                                      |                                   |                                                                             |   |
|                                                                                                                                                                                       | OPEN / CLOSE                                              | <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 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                                                                                                                                       |                                   |                                                                             |   |
| <b>LIMIT SWITCH</b><br>(Not Applicable<br>for Smart                                                                                                                                   | MFR & MODEL NO.                                           | BIDDER TO SPECIFY                                                                                                                                      |                                   |                                                                             |   |
|                                                                                                                                                                                       | OPEN : INT : CLOSE                                        | <input type="checkbox"/> 1 No.<br><input checked="" type="checkbox"/> 2 Nos.                                                                           | 2 Nos. (ADJ.)                     | <input type="checkbox"/> 1 No.<br><input checked="" type="checkbox"/> 2Nos. |   |

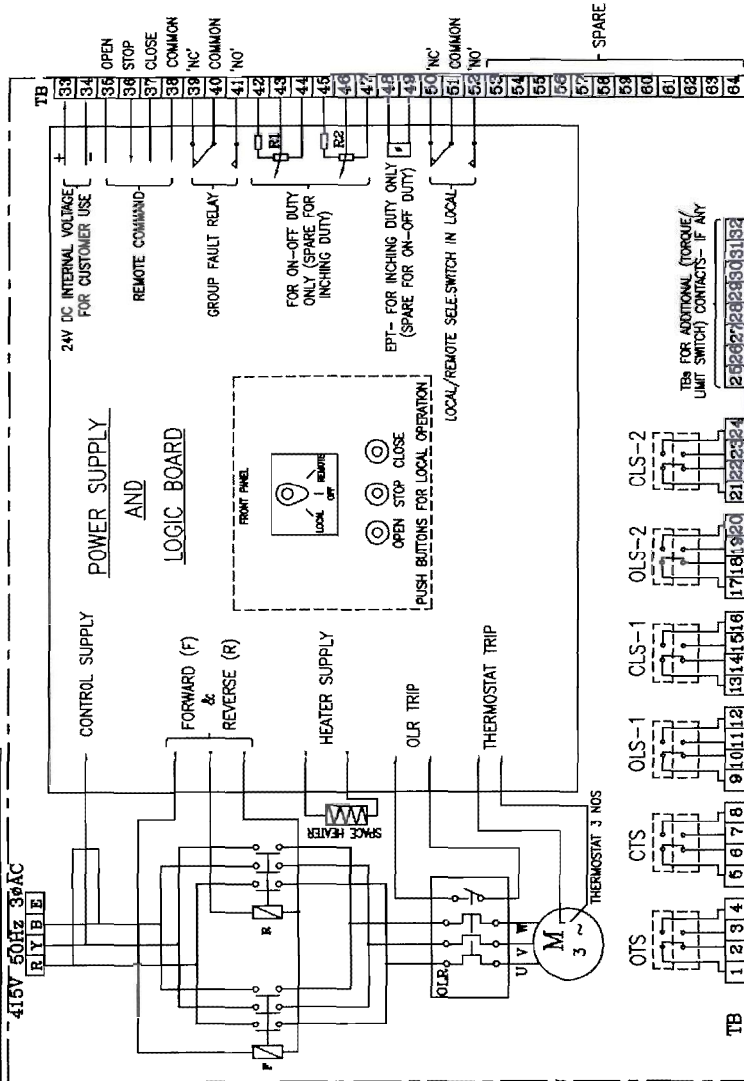
|                                             |                                                                                |                                                                                                                                                                                                                                                                            |                                             |                 |
|---------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------|
|                                             | <b>SPECIFICATION<br/>FOR<br/>MOTORISED VALVE ACTUATOR</b>                      |                                                                                                                                                                                                                                                                            | DOCUMENT NO. : PE-ID-417-145-I902           |                 |
|                                             |                                                                                |                                                                                                                                                                                                                                                                            | VOLUME II B                                 |                 |
|                                             |                                                                                |                                                                                                                                                                                                                                                                            | SECTION D                                   |                 |
|                                             |                                                                                |                                                                                                                                                                                                                                                                            | REV. NO. 00                                 | DATE:15/05/2019 |
|                                             |                                                                                |                                                                                                                                                                                                                                                                            | SHEET 3                                     | OF 4            |
| <b>Data Sheet A &amp; B</b>                 |                                                                                |                                                                                                                                                                                                                                                                            |                                             |                 |
| DATA SHEET-A<br>(TO BE FILLED BY PURCHASER) |                                                                                |                                                                                                                                                                                                                                                                            | DATA SHEET-B<br>(TO BE FILLED-UP BY BIDDER) |                 |
| <b>Actuator) (\$\$<br/>Refer Notes)</b>     | CONTACT TYPE                                                                   | 2 NO + 2 NC                                                                                                                                                                                                                                                                |                                             |                 |
|                                             | RATING (AC / DC)                                                               | 5A 240V AC AND 0.5A 220V DC                                                                                                                                                                                                                                                |                                             |                 |
|                                             | ACCURACY                                                                       | 2% OF SET VALUE                                                                                                                                                                                                                                                            |                                             |                 |
| <b>POSITION<br/>TRANSMITTER</b>             | POSITION TRANSMITTER (For inching duty & other specific applications)          | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                                                                                                                         |                                             |                 |
|                                             | MFR & MODEL NO.                                                                | BIDDER TO SPECIFY                                                                                                                                                                                                                                                          |                                             |                 |
|                                             | TYPE                                                                           | <input type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER<br><input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS                                                                                                                                          |                                             |                 |
|                                             | SUPPLY                                                                         | <input checked="" type="checkbox"/> 24V DC <input type="checkbox"/> .....                                                                                                                                                                                                  |                                             |                 |
|                                             | OUTPUT                                                                         | <input checked="" type="checkbox"/> 4-20mA                                                                                                                                                                                                                                 |                                             |                 |
|                                             | ACCURACY                                                                       | ± 1% FS                                                                                                                                                                                                                                                                    |                                             |                 |
| <b>SPACE<br/>HEATER</b>                     | @SPACE HEATER                                                                  | REQUIRED                                                                                                                                                                                                                                                                   |                                             |                 |
|                                             | @ POWER SUPPLY (NON INTEGRAL)                                                  | 230V AC,1 PH.,50 Hz                                                                                                                                                                                                                                                        |                                             |                 |
|                                             | @ POWER SUPPLY (INTEGRAL)                                                      | BIDDER TO SPECIFY                                                                                                                                                                                                                                                          |                                             |                 |
|                                             | @ RATING                                                                       |                                                                                                                                                                                                                                                                            |                                             |                 |
| <b>TERMINAL<br/>BOX</b>                     | ACTUATOR/MOTOR TERMINAL BOX                                                    | REQUIRED                                                                                                                                                                                                                                                                   |                                             |                 |
|                                             | ENCL CLASS ACTUATOR/MOTOR T.B.                                                 | @ <input type="checkbox"/> IP 68      @ <input type="checkbox"/> .....                                                                                                                                                                                                     |                                             |                 |
|                                             | @ EARTHING TERMINAL                                                            | REQUIRED                                                                                                                                                                                                                                                                   |                                             |                 |
|                                             | PLUG & SOCKET                                                                  | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                                                                                                                                    |                                             |                 |
|                                             | NO. OF PINS REQUIRED(TO BE CHECKED AS PER SIGNALS IN DRIVE CONTROL PHILOSOPHY) |                                                                                                                                                                                                                                                                            |                                             |                 |
|                                             | NOS. OF PLUG & SOCKET                                                          | <input type="checkbox"/> 1 Nos. for ON/OFF <input type="checkbox"/> 2 NOS.(for inching duty)<br><input type="checkbox"/> OTHER (TO BE SPECIFIED INLINE WITH DRIVE CONTROL PHILOSOPHY)                                                                                      |                                             |                 |
| <b>CABLE GLANDS</b>                         | @ POWER CABLE GLAND                                                            | SIZE:-----                                                                                                                                                                                                                                                                 |                                             |                 |
|                                             | @ SPACE HEATER CABLE GLAND                                                     | SIZE:-----                                                                                                                                                                                                                                                                 |                                             |                 |
|                                             | 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.<br>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. |                                             |                 |
|                                             | CONTROL CABLE GLANDS-2                                                         |                                                                                                                                                                                                                                                                            |                                             |                 |
| <b>WEIGHT</b>                               | TOTAL WEIGHT (ACTUATOR + ACCESSORIES)                                          | BIDDER TO SPECIFY                                                                                                                                                                                                                                                          |                                             | _____ Kg.       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                           |                                           |                                                 |                                                                     |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                           |                                           | VOLUME II B                                     |                                                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                           |                                           | SECTION D                                       |                                                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                           |                                           | REV. NO. 00                                     | DATE:15/05/2019                                                     |
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| <b>Data Sheet A &amp; B</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                           |                                           |                                                 |                                                                     |
| DATA SHEET-A<br>(TO BE FILLED BY PURCHASER)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                           |                                           | DATA SHEET-B<br>(TO BE FILLED-UP BY BIDDER)     |                                                                     |
| <b>NOTES:</b> <ol style="list-style-type: none"> <li>1. <b>SCOPE:</b> DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.</li> <li>2. <b>CODES &amp; STANDARDS:</b> DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:<br/>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.</li> <li>3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.</li> <li>4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.</li> <li>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.</li> <li>6. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.</li> <li>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.</li> <li>8. IN ADDITION TO ABOVE REQUIREMENTS FOR LIMIT/TORQUE SWITCH, <b>MECHANICAL END STOP</b> WITH ACCURACY OF 2% SHALL BE SUPPLIED.</li> <li>9. IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.</li> <li>10. LOCAL POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL.</li> <li>11. CONTROL WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM.</li> <li>12. ENDURANCE: RATED TORQUE RANGE SHOULD BE BASED ON ISO 5211, ISO5210.</li> <li>13. TAG PLATE SHALL BE CONFIRMING TO STANDARD BS-15714.</li> <li>14. INTEGRAL STARTER/ACTUATOR DISTURBED SIGNAL SHALL BE CHECKED AND INCLUDE AS PER DRIVE CONTROL PHILOSOPHY.</li> <li>15. <b>** VALVES WITH 10 DEGREE/20DEGREE FEEDBACK REQUIREMENT FOR APPLICATIONS SUCH AS CW/ACW/PLANT WATER SYSTEM ETC SHALL BE CONSIDERED AS INCHING DUTY VALVES. ACCORDINGLY, POSITION FEED BACK TRANSMITTER, PLUG &amp; SOCKET REQUIREMENT SHALL BE CONSIDERED.</b></li> </ol> <p> <b>\$\$ TORQUE SWITCH &amp; LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.</b> </p> <p> <b>## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.</b> </p> |                                                           |                                           |                                                 |                                                                     |
| NAME<br><br>SIGNATURE<br><br>DATE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>PREPARED BY</b><br><br>RINKY                           | <b>CHECKED BY</b><br><br>RAVINDER K RAINA | <b>APPROVED BY</b><br><br>SHIVRAJ SINGH BANSALA | <b>VENDOR COMPANY SEAL</b><br><br>NAME<br><br>SIGNATURE<br><br>DATE |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                           |                                           |                                                 |                                                                     |
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| NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ BE FILLED BY ES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                           |                                           |                                                 |                                                                     |

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

3-V-MISC-24227

ON EXHAUST



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 TYPE, FOR INTCHING 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 3φ 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 |              |            |                |
| OTS    | 5-6          | OPEN AT OVER TORQUE DURING CLOSING TRAVEL  |              |            |                |
|        | 7-8          | CLOSE AT OVER TORQUE DURING CLOSING TRAVEL |              |            |                |
| CLS-1  | 9-10         | ◆                                          |              |            |                |
|        | 11-12        | ◆                                          |              |            |                |
| CLS-1  | 13-14        |                                            |              | ◆          |                |
|        | 15-16        |                                            |              | ◆          |                |
| CLS-2  | 17-18        |                                            | ◆            |            |                |
|        | 19-20        |                                            | ◆            |            |                |
| CLS-2  | 21-22        |                                            |              |            | ◆              |
|        | 23-24        |                                            |              |            | ◆              |
| SWITCH | TERMINAL NO. | FULL OPEN                                  | INTERMEDIATE | FULL CLOSE | VALUE POSITION |
|        |              |                                            |              | b          |                |

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       |      |         |         |
|-------------------------------------------------------------|------|---------|---------|
| VALUES                                                      | OPEN |         | CLOSE   |
|                                                             | MAIN | BACK UP | BACK UP |
| GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS | OLS  | OTS *   | CLS     |
| 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)

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

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

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Size A3



Technical specification for  
**CONTROL & INSTRUMENTATION**  
 5x800 MW YADADRI TPS, NALGONDA

SPEC NO.: **PE-TS-417-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 02.07.2020

SHEET OF

# INSTRUMENTATION DATA SHEET

**VOLUME : VI  
SECTION-VII  
SUB SECTION - B  
CONTROL VALVES**

**1.00.00 GENERAL**

1.01.00 Control valves for regulating service shall normally be globe body, preferably cage guided, metal-to-metal seated, pneumatically operated and shall be provided with characterized plugs

1.02.00 Where high stroking speed , high actuation forces and accurate positioning is critical for the operation of the plant, as in case of HP or LP bypass valves, Separator Drain Valves , hydraulic actuators with electro-hydraulic interface shall be offered.

**2.00.00 GENERAL TECHNICAL REQUIREMENTS**

2.01.00 Bidder shall exercise caution in selecting severe service control valves like BFP recirculation, HP & LP bypass, superheater & reheater attemperator, PRDS for Boiler & Turbine, Feed control station ,Soot blower steam pressure, Fuel oil heating and pressurizing ,minimum economizer flow control ,DM make up ( emergency / normal ), control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water, separator level control , CEP minimum flow control etc. For such critical applications, Bidder shall offer valves which are proven for similar application. Above valves shall have leakage class equal or better than class-VI with metal-to-metal seating.

2.02.00 Valve with ANSI leakage class-V shall be provided for all applications except for the control valves indicated above.

2.03.00 Bidder shall provide redundant control valves for some services such as Main condensate flow control, Superheat attemperation control and Reheat attemperation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided.

2.04.00 Control valves shall be located near floor or platform for ease of access and with adequate clearances for maintenance and lay-down and shall be placed as station with upstream motorized isolating valve, down-stream motorized isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down-stream motorised isolating valves. Where quick shut off requirement is foreseen such as in case of SH & RH attemperation valves, upstream isolation valve shall be pneumatic type.

2.05.00 Wherever, steam conditioning calls for , Pressure reducing & desuperheating, combined PRDS type valves shall be offered.

2.06.00 Control Valve shall be furnished with IBR certification wherever required .

2.07.00 Valve Body / End Connections

2.07.01 Valve end to end dimension and connection shall be according to ANSI standard, straight through pattern. 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 inlet pressure.

2.07.02 Control valves of 40 mm. size and above with line pressure up to 50 Kg / Sq. cm may have flanged or welded end connections.



- 2.07.03 Control valves, used in high pressure services shall have butt welded end connections for size 65mm and above and socket weld end connection for size 50 mm or below.
- 2.07.04 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.
- 2.07.05 Bonnet joints for all control valves shall be of flanged and bolted type.
- 2.07.06 Flanged valve shall be rated at no less than class 300 lbs
- 2.07.07 The direction of flow shall be clearly engraved on the body . Valve tag no, , description or purpose, stroke time shall be painted on all control valve body with black letters on white background in Bold letters.
- 2.07.08 Valve Body Materialial shall match the process conditionrequirement as per ANSI. . General guideline shall be as follows

| <b>SR. No.</b> | <b>SERVICE</b>                                                                           | <b>MATERIAL</b>                                                                                        |
|----------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| 1.             | Non corrosive, non-flashing and non cavitating service for fluid temperature up to 275°C | Cast carbon steel ASTM A216 Gr. WCB , Trim material - 316 SS stellited faced GUIDe posts and bushings. |
| 2.             | Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C | Cast alloy steel ASTM A217 Gr. WC9 Trim material - 316 SS stellited faced GUIDe posts and bushings.    |
| 3.             | Severe flashing / cavitating services                                                    | Alloy steel ASTM A217 Gr. WC9 , Trim material - 440C                                                   |
| 4.             | Low flashing / cavitating services                                                       | Alloy steel ASTM A217 Gr. WC6 ,Trim material - 17-4 PH SS                                              |
| 5.             | DM water application (condenser hotwell normal, emergency make up etc.)                  | 316 stainless steel                                                                                    |

- 2.07.09 Bidder may supply valves with body and trim materials with superior quality than specified material and in such cases Bidder shall furnish the comparison of offered material properties ,such as cavitation resistance , , hardness , tensile strength , strain energy , corrosion and erosion resistance etc. , with specified material for Owner's approval.

**2.08.00 Valve Size**

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

- a) The valves shall pass normal flow (MCR condition) with 60 to 70 percent opening for linear characterised valves and between 70 to 80 percent opening for equal percentage characterised valves.

- b) The valves shall have adequate rangeability to pass the minimum and maximum flows at 10% and 85% 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 maximum 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) Trim exit outlet velocity as defined in ISA handbook does not exceed 8 m / sec for liquid services , 150 m/sec for steam services and 50% of sonic velocity for flashing services The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard.
- 2.09.00 Valve Top work
- 2.09.01 Top work 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.
- 2.09.02 Extended bonnet/ bonnet when maximum temperature fluid is greater than 280<sup>0</sup> C shall be provided and high temperature packing shall also be used for high temperature application.
- 2.09.03 The gland material shall be chosen to suit the operating temperature. PTFE may be chosen for lower temperature application (232°C maximum) and for high temperature application graphited asbestos glands are to be provided. For vacuum services,. All valves connected to vacuum on downstream side shall be provided with packing suitable for vacuum applications eg. double vee type chevron packing.
- 2.10.00 Valve Trim
- 2.10.01 Valve trim for 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 or treatment such as nitride shall be used if severe erosion is expected.
- 2.10.02 Balanced trim valves shall be offered for high shut-off pressure or high pressure drop condition to reduce the size of the actuators.
- 2.10.03 For flashing services and two stage mixtures, the trim material shall be 17-4 PH SS or equivalent.
- 2.10.04 If cavitating condition is foreseen, Bidder shall offer multistage or labyrinth trims valves. Trim of severe service valves shall be of multistage and multipath design with number of discrete pressure drop stages to eliminate the chances of erosion, cavitation, noise and vibration throughout the control range of the valve.
- 2.10.05 Quick replacement type trim shall be considered for easy maintenance.
- 2.10.06 Plug shall be one-piece construction cast , forged or machined from solid bar stock .Plug shall be screwed or pinned to valve stems or shall be integral with the valve stems.

- 2.11.00 Noise Level
- The equivalent sound level measured at 1.5M 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. The noise abatement shall be achieved by valve body & trim design and not by use of silencers. Valve Actuators
- 2.12.00 Actuator
- 2.12.01 Spring-diaphragm type actuators shall generally be used. Piston type actuators shall be offered in case of high shut-off pressure & quick response requirement. Hydraulic actuation system shall be provided for Critical valves as described elsewhere in the specification.
- 2.12.02 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.
- 2.12.03 Diaphragms shall be designed for 200% maximum operating pressure.
- 2.12.04 Nylon reinforced neoprene is preferred as diaphragm material.
- 2.12.05 Valve actuators shall be capable of operating at 80<sup>0</sup> C ambient, continuously.
- 2.12.06 Entire actuator assembly shall be painted with corrosion inhibiting paint.
- 2.12.07 Air connection size shall be 1/4" NPT (F) unless otherwise dictated by process response time. Integral tubing shall be stainless steel.
- 2.12.08 Bidder shall indicate the stroking time of the valve assemblies with positioned and ensure that the stroke time shall meet the process and equipment dynamics and shall be better than 10 seconds.
- 2.12.09 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.
- 2.12.10 Hydraulic actuation system
- The system shall consist of , but not limited to , Hydraulic cylinder , proportional valve with blocking unit , SMART positioner with position transmitter , SOVs , safety bypass unit , safety control unit , Hydraulic supply unit and local controller cubicle with controller unit
- 2.13.00 Valve Positioners
- 2.13.01 All regulating service valves shall be offered with HART protocol based Smart Electro Pneumatic Positioners to ensure accuracy and repeatability of response.
- 2.13.02 Positioners shall have integral non contact type position transmitter, input and output gauges, local keypad & display and 4-20 mA DC output to DDCMIS in CCR.
- 2.13.03 Positioners shall be capable of functioning under hot, humid and vibrating conditions.
- 2.13.04 Positioner casings shall be dust tight, corrosion resistant and weatherproof to IP 65 .and explosion proof in hazardous areas.

- 2.13.05 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.
- 2.13.06 Remote calibration from control room shall be possible through HART management station.
- 2.14.00 Performance
- 2.14.01 Performance of the complete assembly of the control valves shall be better than +/- 1% of FS for linearity , +/- 0.5 % of FS for hysteresis , 1% for accuracy.
- 2.15.00 Valve Accessories
- 2.15.01 Accessories shall include side mounted hand wheels, open & close , intermediate ( as applicable ) limit switches for both regulating and On off valves ,, junction boxes with 20 % spare terminals , Air filter regulators , airlock relays , volume chambers etc. Solenoid valve (SOV) wherever required shall be furnished. Each limit switch shall have not less than 2 NO & 2 NC contacts with contact rating 5A , 240 V AC / 0.5 A , 220 V DC . SOV shall have SS bar stock body , SS316 Trim , SS coil enclosure , Class H insulation Air filter regulator shall have sintered bronze filter element with maximum 5 microns filter size & 2 inch dial size pressure gauges. .Protection class of all Limit switches , junction boxes , SOV etc. shall have protection class IP 65 and explosion proof for hazardous areas.
- 2.15.02 Air distribution line to all final control elements like control valves, pneumatic dampers (both regulating / on-off type) , SOV operated valves shall be through SS manifolds and SS isolating valves only. These valves shall be properly tagged also with KKS tag no. and description of final control element / instrument for which they are intended.
- 2.16.00 Test and Examination
- All valves shall be tested in accordance with the Quality Assurance programme agreed between the Owner and Bidder , which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specification . The test shall include but not be limited to Non destructive test , Hydrostatic shell test prior to seat leakage test , Seat leakage test , Valve closure test , Functional test of fully assembled valves including actuators and accessories. CV test etc. For all control valves Cv test shall be witnessed by Owner.

**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"> <li>a. Universal mounting bracket suitable for 2" pipe mounting</li> <li>b. High tensile carbon steel U-bolts</li> <li>c. Siphon for steam and hot water services</li> <li>d. ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock</li> <li>e. Companion flange with nuts, bolts and gaskets</li> <li>f. ½" NPT cable gland</li> <li>g. Handheld calibrator</li> </ul> |
| 19. | Adjustment/Calibration/<br>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                               |

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- |     |                     |   |                                                                                                                                                               |
|-----|---------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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         | : | a. Universal mounting bracket suitable for 2" pipe mounting<br><br>b. High tensile carbon steel U-bolts                                                       |

- 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



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|     |                                     |   |                                                                                                                                                                                                                                                     |
|-----|-------------------------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | 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                         | : | <ul style="list-style-type: none"> <li>a) Counter Flange, nuts, bolts, gaskets etc</li> <li>b) Weights for 5 point calibration of instruments</li> <li>c) Vent and drain plugs</li> <li>d) ½" NPT Glands</li> <li>e) Handheld calibrator</li> </ul> |
| 24. | Preferred Features                  | : | <ul style="list-style-type: none"> <li>a) Test plug connection and cutout terminals physically separated from other electronics</li> <li>b) Electronic Damping facility (adjustable)</li> </ul>                                                     |
| 25. | Adjustment/Calibration/ Maintenance | : | From handheld calibrator/ HART management system                                                                                                                                                                                                    |

26. Applications : During detail engineering on Owner's approval

1.04.00 MASS FLOW METER

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.

1.04.02 TRANSMITTER

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

- |                                             |   |                                                                                                                                                                                           |
|---------------------------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7. Turn Down                                | : | 100:1                                                                                                                                                                                     |
| 8. Accuracy                                 | : | $\pm 0.2$ % of measured value                                                                                                                                                             |
| 9. Housing                                  | : | IP 65 (Explosion proof)                                                                                                                                                                   |
| 10. Nameplate                               | : | Tag number, service engraved in stainless steel tag plate                                                                                                                                 |
| 11. Accessories                             | : | <ul style="list-style-type: none"> <li>a) Handheld calibrator</li> <li>b) Mounting U-bolts, nuts, bolts, prefab cable etc</li> <li>c) <math>\frac{1}{2}</math>"NPT cable gland</li> </ul> |
| 12. Adjustment/Calibration/<br>/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               | : | <ul style="list-style-type: none"> <li>a) Self calibration with internal reference</li> <li>b) Zero &amp; Span calibration</li> </ul> |
| 8. Process Connection        | : | External cage mounting<br>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) |

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- |                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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="display: flex; align-items: flex-start; margin-top: 10px;"> <div style="margin-right: 20px;">b)</div> <div>Weather canopy for protection from direct sunlight and direct rain</div> </div> <div style="display: flex; align-items: flex-start; margin-top: 10px;"> <div style="margin-right: 20px;">c)</div> <div>½"NPT cable gland</div> </div> <div style="display: flex; align-items: flex-start; margin-top: 10px;"> <div style="margin-right: 20px;">d)</div> <div>All mounting hardware (SS-316), Prefab cable</div> </div> <div style="display: flex; align-items: flex-start; margin-top: 10px;"> <div style="margin-right: 20px;">e)</div> <div>SS Nameplate</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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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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 be provided for Raw water/ Cooling Water flow measurements.*

transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters 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
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

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- |                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14. Nameplate    | : | Tag number, service engraved in SS tag plate                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 15. Accessories  | : | <ul style="list-style-type: none"> <li>a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary for corrosive/ viscous/ solid bearing or slurry type fluid applications</li> <li>b) Snubbers for pulsating fluid applications</li> <li>c) Siphons for steam and hot water services</li> <li>d) Retention ring and screws for surface mounting</li> <li>e) 1/2" NPT 2 Valve SS-316 barstock manifold</li> <li>f) 1/2" NPT cable gland</li> </ul> |
| 16. Applications | : | During Detail Engineering on Owner's approval                                                                                                                                                                                                                                                                                                                                                                                                                       |

**3.02.00 DIFFERENTIAL PRESSURE SWITCH**

- |                             |   |                                                                                                                                                        |
|-----------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Type                     | : | <ul style="list-style-type: none"> <li>i. Piston for high pressure application</li> <li>ii. Bellow / Diaphragm for low pressure application</li> </ul> |
| 2. Sensing element material | : | SS-316.<br>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                                                                                                                              |



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- |                         |   |                                                                                                                                                                      |
|-------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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                               |
| Application                 |   |                                        |
| 4. Temperature              | : | 250°C (Max.)                           |
| Electronic Controller       |   |                                        |
| 5. Input Supply Voltage     | : | 240V AC ±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                           |
|                             |   | Power On                               |
| 10. Local LED Indication    | : | Alarm Level                            |
|                             |   | Probe Healthy                          |
| 11. Switching Repeatability | : | ±0.5%                                  |
|                             |   | Co-axial cable for probe connection to |
|                             |   | controller                             |
| 12. Accessories             | : | SS Tag plate                           |
|                             |   | ½" 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    |
| Application      |   |                             |
| 4. Temperature   | : | 250°C (Max.)                |
| 5. Test Pressure | : | Two times rated pressure    |

- 
- |     |                      |   |                                                                                                                                                                                                                                                          |
|-----|----------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6.  | Input Supply Voltage | : | 240V AC $\pm$ 10%, 50 Hz.<br>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<br>HI,LO, HIGH-HIGH, LOW-LOW                                                                                                                                                                                                                          |
| 12. | Local LED Indication | : | Power<br>Fault                                                                                                                                                                                                                                           |
| 13. | Accessories          | : | <ul style="list-style-type: none"> <li>a) Interconnecting cable from probe to electronics</li> <li>b) Mounting accessories</li> <li>c) External cage</li> <li>d) Washer &amp; Gasket</li> <li>e) ½" NPT Cable Glands</li> <li>f) SS Tag Plate</li> </ul> |
| 14. | Application          | : | During Detail Engineering on Owner's approval                                                                                                                                                                                                            |

**3.07.00 TEMPERATURE SWITCH**

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

- 
- |     |                       |   |                                                                                                                                                      |
|-----|-----------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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<br>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, ½" 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                                        |
| 10. Adjustment           | : | For Zero adjustment (Micrometer screw external)<br>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 $\pm 1.0$ % 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<br>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 :  $\pm 10$  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  
iii. Companion Flanges, Bolts, nuts, gaskets, SS Tag plate  
iv. Illuminating lamps, Mica shield as 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 : Stainless Steel  
/Followers/ Other wetted parts
  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).<br>b) 30 sec. (with thermowell) |
| 7. Calibration                   | : | DIN 43760                                          |
| 8. Accuracy                      | : | ± 0.5%                                             |
| 9. Head                          |   |                                                    |
| a) Type                          | : | IP-65 universal screwed type                       |

- b) Material : Stainless Steel
- c) Terminal blocks : Nickel plated Brass-screw type / silver plated
- d) Cable connection : ½" NPT gland and grommet
- e) Others : Terminal head cover with SS chain and suitable gasket.

Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

- Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT] with thermowell connection
- 10. Accessories :
  - a)
  - b) Compression fittings/unions
  - Flanges etc. (for flanged connections only)
  - c)
  - Thermowell (As specified below)
  - d)

- 11. Thermowell connection : ½" NPT (M) or 150 RF Flanged
- Tag number, service engraved in
- 12. Nameplate : stainless steel tag plate

*Note:* The specifications for RTDs of winding/ bearing of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be Pt-100.

5.02.00 THERMOCOUPLES

1. Type :
  - a) 16 SWG wire of Chromel Alumel) (Type-K)
  - b) Duplex
  - c) Ungrounded
2. Protecting Tube
  - a) O.D. : 6 mm
  - b) Material : SS-316, Seamless
  - c) Filling : Magnesium oxide (Purity above 99.4%).
3. Response time :
  - a) < 20 seconds for measurement
  - b) < 10 seconds for control
4. Accuracy :  $\pm 1.1^{\circ}\text{C}$  up to  $300^{\circ}\text{C}$  & 0.4% of measured temperature range above  $300^{\circ}\text{C}$
5. Head
  - a) Type : IP-65 universal screwed type
  - b) Material : Stainless Steel
  - c) Terminal blocks : Nickel plated Brass-screw type / silver plated
  - d) Cable connection :  $\frac{1}{2}$ " NPT gland and grommet
6.
  - e) Others : Terminal head cover with SS chain and suitable gasket.

Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

7. Accessories :
  - a) Adjustable nipple-union-nipple [1/2" Sch 80 X 1/2" NPT] with thermowell connection
  - b) Compression fittings/unions
  - c) Flanges etc. (for flanged connections only)
  - d) Thermowell (As specified below)
8. Thermowell connection : 1/2" NPT (M) or 150 RF Flanged
9. Nameplate : Tag number, service engraved in stainless steel tag plate

#### 5.03.00 TEMPERATURE GAUGE

1. Type : Expansion type (Liquid filled system)
2. Sensing Element : Bourdon – SS-316
3. Bulb and Capillary Material : SS-316
4. Capillary Tubing : Inner sheath - solid drawn Material  
copper tube  
Outer sheath - PVC tube
5. Movement Materials : Stainless Steel / Direct Bourdon tip connection to pointer spindle
6. Case Material : Stainless Steel stove enameled, black finish, threaded bezel ring, clear glass

- 
- cover conforming to IP 65.
7. Dial size : 150 mm
  8. Scale : Black lettering on white background in 270 Deg.C arc
  9. Over range protection : 125 percent of FSD
  10. Capillary Glanding : 1/2" NPT(M) x compression fitting (SS) to suit capillary
  11. Instrument Connection : Bottom connection for local mounting, back connection for panel mounting
  12. Process Connection : 1/2" NPT (M) or 150 RF Flanged
  13. Extension Neck Length : 50 mm
  14. Compensation : a) Capillary compensation
  15. : b) Case compensation
  16. Performance : a) Accuracy : + /- 1.0 percent of full scale Deflection
  - : b) Repeatability : Less than 0.5 percent of full range
  - : c) Response time: 15 seconds (max.).
  17. Capillary length : 3.0 meters (local) / 15.0 metres (local panel)
  18. Other features : Shatter proof glass
  19. Nameplate : Tag number, service engraved in stainless steel tag plate
  20. Accessories : SS316 Thermowell

5.04.00 THERMOWELL

1. Material : SS-316
2. Manufacture : Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)

3. Process connection : M33x2
4. Certification : Not applicable
5. Bore concentricity : +5% of wall thickness
6. Identification mark : Tag number punched on head
7. Surface treatment : Polish after machining
8. Element connection : ½" NPT (M) or 150 RF Flanged
9. Head : Hex
10. Length of the hex head : 31.75 mm (min.)
11. Accessories : SS Plug and chain for test thermo wells  
SS Nameplate, Flange with companion  
flange & all required accessories for  
flanged connections.

*Note: Wake frequency calculations shall be furnished for all thermowells for approval.*

*Thermowells shall be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid.*

5.05.00 METAL TEMPERATURE THERMOCOUPLE

1. Measuring medium : Metal temperature
2. Type : Chromel Alumel (Type-K)  
Duplex, Ungrounded
3. Insulation : Mineral Insulation Magnesium Oxide
4. Wire gauge : 16 AWG
5. Protective sheath : SS
6. Protective sheath :  
diameter 8 mm O.D.
7. Characteristics : Special limits of error as in ANSI  
thermocouple MC 96.01
8. Accessories : ½" BSP SS sliding end connector, weld  
pad, clamps of heat resistant steel



- |    |                |   |                             |
|----|----------------|---|-----------------------------|
| 1. | Type           | : | Hydrometer Type             |
| 2. | Mounting       | : | On line                     |
| 3. | Accuracy       | : | +/- 2% of range             |
| 4. | Scale          | : | Black letter on white scale |
| 5. | End connection | : | PVC flange                  |

**9.06.00 DENSITY/ CONCENTRATION METER**

- |    |                    |   |                                                                                         |
|----|--------------------|---|-----------------------------------------------------------------------------------------|
| 1. | Wetted Part        |   | Stainless Steel                                                                         |
| 2. | Enclosure          |   | Stainless Steel (IP-65)                                                                 |
| 3. | Power Supply       |   | 24 V DC                                                                                 |
| 4. | Output signal      | : | 4-20 mA DC (isolated) into 600 ohms                                                     |
| 5. | Accuracy           |   | ±0.001 g/cc                                                                             |
| 6. | Indication         | : | LCD display                                                                             |
| 7. | Temp. Compensation | : | Integral                                                                                |
| 8. | Accessories        |   | Mounting hardware, integral amplifier<br>(if required), cable glands, tag plate<br>etc. |

**10.00.00 SOLENOID VALVES**

- |    |                     |   |                                      |
|----|---------------------|---|--------------------------------------|
| 1. | Operating Principle | : | Electromagnetic (noiseless)          |
| 2. | Coil voltage rating | : | 240 V AC /24 V DC (as required)      |
| 3. | Ways                | : | 2/3/4 way                            |
| 4. | Port size           | : | 1/4" NPT all ports                   |
| 5. | Body                | : | SS bar stock                         |
|    | Trim                | : | SS-316                               |
| 6. | Duty                | : | Suitable for continuous energization |
| 7. | Sealing             | : | Airtight and leak proof              |
| 8. | Ambient Temperature | : | 0 - 50 ° C                           |

- 
- |     |                   |   |                                                          |
|-----|-------------------|---|----------------------------------------------------------|
| 9.  | Fluid Temperature | : | 0-150 ° C (approx.)                                      |
| 10. | Coil Enclosure    | : | Stainless Steel                                          |
| 11. | Insulation        | : | Class-H                                                  |
| 12. | Coil Casing       | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area) |
| 13. | Mounting          | : | On pipe or on panel                                      |
| 14. | Cable Connection  | : | ½" NPT                                                   |
| 15. | Accessories       | : | Cable glands, SS Tag plate                               |

Note : Solenoid valves shall be kept in pneumatic junction boxes only. Air distribution for SOV's shall be through SS manifold with SS isolation valves and auto drain traps and SS tubing from SOV to valves shall not be more than 6 meters.



Technical specification for  
**CONTROL & INSTRUMENTATION**  
 5x800 MW YADADRI TPS, NALGONDA

SPEC NO.: **PE-TS-417-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 02.07.2020

SHEET OF

**PLC SPECIFICATION WITH  
 CONFIGURATION DIAGRAM  
 AND  
 UPS SCHEME WITH  
 SPECIFICATION**

## **PROGRAMMABLE LOGIC CONTROLER (PLC) / PROPRIETARY CONTROL SYSTEM**

**1.00.00 GENERAL**

- 1.01.00 Each of the relevant BOP areas and different auxiliary systems shall be provided with dedicated PLC or proprietary control systems for overall operation and control.
- 1.01.01 The Common DDCMIS network shall also control and monitor the packages envisaged for PLC based local control systems. Operator workstations shall be provided in CCR for the overall control and monitoring of each system through network.
- There shall be redundant bidirectional OPC link between this Common DDCMIS network and each Package PLC including PADO for monitoring / performance activities.
- These areas have been indicated with other details in Section-V of this volume of the specification.
- 1.02.00 These control systems shall conform to high standard of engineering meeting all applicable codes and standard, design and workmanship and shall meet the functional requirements in all respects and shall be capable of performing satisfactorily in continuous commercial operation under the specified environmental condition.
- 1.03.00 Further this part of the specification details the common technical and functional requirements applicable for all the systems unless specified elsewhere in the specification. Only specific requirements are indicated in this section .However ,Bidder shall also adhere to the Section-VI , Subsection A (DDCMIS) of this volume of the specification for other basic and detailed scope & services , philosophy & technical requirements of different hardwares and softwares including response time , loading , interface , redundancy criteria , display , logs ,spares criteria , drawings and document submission etc.
- 1.04.00 All local PLCs shall be supplied from one manufacturer for all plants and shall provide single unified hardware and software platform for realizing all the control and monitoring functions.
- 1.05.00 In general local PLC, ,Proprietary control system by third party system integrators shall not be allowed and only main PLC/ Proprietary control system manufacturer shall be allowed to do the design engineering , system integration etc. Owner will be the final authority in allowing third party system integrators , if required , for only small applications
- 1.06.00 Common DDCMIS shall basically control and monitor the BOP package systems , as detailed in section V of the volume of specification , through the workstations from the Central Control Room (CCR) during normal operation of the plant.. However, local control and monitoring facility of the equipments from the respective package control room and local panels shall also be available. However, if required, based on operator choice, normal and emergency operation from the local PLC system shall also be done. The control room operator shall have also access to common database for all the packages.

- 1.06.01 The redundant upper level network of each Package PLC system will be connected to redundant server to be located in Plant Engineer's room. Suitable Fibre optic cable shall be used for redundant interconnections.
- 1.06.02 The hot redundant Server shall continuously update all the inputs. The switchover to the hot standby Server shall be smooth and bump less with proper indication to the operator.
- 1.06.03 In addition to local PLC Workstations , programming activities for control systems of all the packages including set point change , logic build up & modifications , graphics build up & modifications etc . shall also be achieved through Common DDCMIS network workstation.
- 1.06.04 Common DDCMIS Network workstations stations, local workstations shall have access to the processor of the individual package control system for programming. Programming shall not require special computer skills. On the programming console, it shall be possible to do the programming, self-diagnostics, testing of sequence, simulation and any sequence modification.
- 1.06.05 All the screens as available in the local package monitors will be also available one to one basis in the Common DDCMIS network screens. Alarm monitoring / reporting, generation of logs, trends, calculations, printing of logs & reports etc. shall be available in local workstations as well as in remote Common DDCMIS network workstations .In case of failure of Common DDCMIS network, control and monitoring of the individual packages shall still be possible from the Operator Work Stations in the respective package control room
- 1.06.06 There shall be flexibility in operation from CCR Common DDCMIS network operator workstations. Any of the BOP packages can be controlled and monitored from any of the workstations. .
- 1.06.07 The system shall permit carrying out of the on-line dynamic test and self-diagnostic checks while maintaining safe condition and without endangering the safety of equipment without having any influence on the process being controlled.
- 2.00.00 **GENERAL TECHNICAL REQUIREMENTS**
- 2.01.00 Bidders scope of supply shall include , but not limited to , Hot standby local PLC / Proprietary control & monitoring system for each of BOP areas and shall consist of IO cards, remote and Local IO rack, control rack, redundant Power supply modules, redundant communication /networking and interconnection Cables, redundant processor and communication cards, redundant Servers, operator work stations / GUI , LVS , printer, redundant networking hardware, redundant interface hardwares / softwares with DDCMIS , MCS , PADO etc. , system cabinets ,startup, commissioning, mandatory and recommended spares, drawing, documents and training to owner's personnels at site and at vendors works etc.
- 2.02.00 All types of programming packages shall be licensed with facility of editing and configuration. For each of the PLC / proprietary control system, the programming software shall be supplied in a laptop for each package

preloaded with package in addition to other types of devices such as CD, DAT etc.

2.03.00 In addition to the Operator and/ cum Engineering workstations , Bidder shall also supply LCD screen based display unit, control switches and other operational keys (GUI). Bidder shall also provide minimum of one no. laptop computer for each PLC based package and with latest hardware configuration and loaded with suitable operating , application program including licensed softwares as a backup engineering cum programming and configuration station. This loaded laptop shall be handed over by Bidder well in advance of FAT to Owner's head office at Hyderabad .

2.04.00 The System shall allow dependable and effective control of the process equipment and shall be designed for maximum integrity and reliability. Integrity shall be maintained by providing a dual hot redundant system .The System shall have a capability to monitor and take actions for distributed functions from a central location.

2.05.00 The control & Instrumentation shall be through dedicated microprocessor based PLC ,Common DDCMIS network ,proprietary system for the each of the respective plants covering the total functional requirement of sequence control, regulatory control, interlock & protection, monitoring, alarm, data logging.

2.06.00 The loop cycle time shall be less than 1 sec for close loops and open loops. The switchover from main controller to redundant controller shall be bumpless; and shall be within one cycle time i.e. within 50 msec.

2.07.00 Each controller shall have 40% functional capacity to implement additional functional blocks over and above implemented logic / loops under worst loading conditions.

2.08.00 Field Input/Outputs

The System shall meet the following I/O card requirements.

The maximum number of inputs / outputs to be connected to each type of module shall be as follows:

|     |                      |    |
|-----|----------------------|----|
| a)  | Analog input module  | 8  |
| b). | Analog output module | 8  |
| c)  | Binary input module  | 16 |
| d)  | Binary output module | 16 |

2.09.00 Communications System

2.09.01 The Bidder shall include a dual hot redundant communication system

2.09.02 The data highway speed shall be 1000 Mbps.

2.10.00 Operator Interface

Operator Work Station (OWS) / GUI / LVS shall perform control monitoring and operation of all auxiliaries/ drives . However , Push button stations are

also to be provided with RIOs as detailed out in Section V of this volume of the specification .

- 2.11.00 Interface with Common DDCMIS system
- Each PLC , proprietary control systems shall be interfaced to Common DDCMIS network with bidirectional OPC link .The link shall be redundant.
- 2.12.00 PLC shall be of latest version and all the modules like Control modules, communication modules, IO modules, network interface modules etc., modules shall be from the same family of hardwares and softwares and shall be sourced from Bidder's Original Principial's works.
- 2.13.00 PLC shall have also , but not limited to, the following requirements ,
- 2.13.01 I/O LAN Speed shall be minimum 5 Mbps - 100 MBPS on Deterministic LAN.
- 2.13.02 I/Os shall be Rack based and not Din Rail Mountable .
- 2.13.03 Processors and I/Os shall be of same family.
- 2.13.04 Channel Level Diagnostics for DI/DO, AI & AO shall be provided . Each individual Channel healthiness shall be monitored at workstation / GUI level.
- 2.13.05 All PLC I/O Rack Power Supplies shall be redundant. Only Bulk power supply redundancy will not be acceptable.
- 2.13.06 Processor shall have minimum 256 PID loops execution capability. Minimum memory shall be 10 MB. It should be 32 Bit.
- 2.13.07 SOE module (if applicable) must stamp and store 250+ events at card level.
- 2.13.08 PLC shall store tag details and bit word addresses on upload of logic as well as tag descriptions.
- 2.13.09 I/O Bit forcing in Primary to reflect in secondary immediately. (single scan update)
- 2.13.09 Remote I/O Rack outside control room shall be on Fiber Optic communication only.
- 2.13.10 Processor shall be self learning in case of failure. No need to configure and program replaced processor.
- 2.14.00 Operating work stations must be Runtime license/servers. Client server architecture no acceptable.
- 2.15.00 Each operator work station must have minimum 8000 tags handling capability.
- 2.16.00 Auto Tuning feature of PIDs at PLC controller level shall be available.
- 2.17.00 Floating IP selection of Controller under PLC processor switchover condition



- 2.18.00 Automatic Program update on secondary on loading to Primary Processor.
- 2.19.00 Programming facility shall be available from Remote IO stations.
- 2.20.00 Processor shall support minimum 22000 IO handling capacity in Redundant configuration.
- 2.21.00 Online editing of Program shall be possible.
- 2.22.00 Processors shall be Hot back up.
- 2.23.00 Automatic synchronization of primary processor/controller of PLC with secondary processor/controller.
- 2.24.00 Bumpless switchover to secondary processor/controller of PLC when the primary fails.
- 2.25.00 Power supply module redundancy shall be true power supply redundancy
- 2.26.00 Automatic program and data equalization of primary processor/controller of PLC.
- 2.27.00 Automatic 'Forcing Bit' update in the secondary processor/controller of PLC when any Forcing is applied in the primary processor/controller of PLC. (Forcing Bit Table of both the PLCs must be automatically synchronised.)
- 2.28.00 Communication speed of 5 Mbps between PLC and I/O module network
- 2.22.00 Softwares
- The latest version of all necessary applications and networking software shall be supplied for the system. The software tool shall have facility to interface with third party software packages. Window base operating system shall be provided. The system shall be OPC compliant. Easy upgradation and future expansion facility shall be available.
- All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant. User shall not have to pay any recurring license fee during the usage period of the system.
- It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life.
- 2.23.00 Redundant Uninterrupted Power Supplies (UPS) shall be provided for each Local PLC.. UPS specification shall be as per requirements indicated in Section V of this specification.

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## 1. SCOPE

This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to site, erection and commissioning of the PLC Control & Monitoring System comprising PLC Control panel/Remote I/O panel (housing Processors, I/O cards, power supply packs etc.), Operator workstations(OWS), Printers, Annunciation system, UPS, cables and all other equipments and accessories required for completeness of the system as mentioned in different sections of this specification.

## 2. GENERAL

- 2.1. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, math functions, input quality checking engineering unit conversion, Boolean functions & PID control (Analog logic function).
- 2.2. The system shall be redundant in processor, power supply and communication interfaces unless otherwise specified. The system shall have self-diagnostic features. The control of all drives and equipment shall be effected through the keyboard/mouse / panel mounted push button / control switches as per Data sheets-A&B.
- 2.3. The system shall have facility for connecting to Main Plant's Distributed control system (DCS) using hardware / software interface for two-way transfer of signals.
- 2.4. The mimic shall be displayed on the OWS screen and may also be provided on the control desk/panel (as per Data sheets).
- 2.5. In case OWS is provided, HMI functions like Trends, Curves, Bar charts, Historical storage of Data, Logs and reports etc. shall be provided in addition to Plant-schematics. The necessary catalogue / literature elaborating the features of HMI shall be supplied along with the bid.
- 2.6. It shall be possible to use the same OWS as programming station.
- 2.7. The PLC system shall be sized to meet process/system requirements as per the approved P&IDs and Control write-up.
- 2.8. The PLC system shall be designed to ensure that no single device failure should result in failure of any other device.
- 2.9. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.

## 3. TECHNICAL REQUIREMENTS

Details of various PLC system components shall be inclusive of but not limited to the following:

### 3.1. CODES AND STANDARDS

- 3.1.1. The equipment covered under this specification shall meet the requirements of latest edition of all applicable codes and standards like ANSI, NEMA, IEEE, IEC, NEC

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3.1.2. PLC shall conform to IEC: 1131

3.1.3. The offered PLC shall comply with safety standards as per Data sheet-A&B.

### 3.2. CONTROL PANEL

3.2.1. PLC control panel shall be freestanding type with provision for mimic display, push-button stations, control switches, indicating lamps, metering instruments like Indicators, ammeters etc. and facia windows for critical alarms.

3.2.2. The salient features of construction shall be:

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

Enclosure thickness: Not less than 2.0 mm for load bearing sections (mounted with instruments) and Not less than 1.6 mm for others

Gland plate thickness: 3.0mm

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

3.2.3. Each panel shall be identified by a name plate, which shall be of non-rusting metal or three ply lamicold, with engraved lettering.

3.2.4. 25 x 6 mm Copper ground bus to be provided for each panel.

3.2.5. 240V AC single phase, thermostatically controlled space heaters shall be provided. Each free standing panel shall have a door switch operated fluorescent lamp and a 240V AC plug point.

3.2.6. Painting treatment shall be as per IS: 6005. Two coats of lead oxide primer shall be followed by powder coating. Paint shade shall be as specified in the "Data sheet for PLC system"-Data Sheet-A&B.

3.2.7. The annunciation system shall be facia window type, driven by the PLC. Audible alarm, Acknowledge, Reset and lamp test facility shall be provided as per ISA sequence – S18.1, M.

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### 3.8. COMMUNICATION WITH PLANT DCS

- 3.8.1. The PLC system shall be provided with hardwired/serial interface for communication with plant DCS.
- 3.8.2. Serial communication to / from DCS where provided shall be engineered to ensure that signal communication time from / to DCS shall not exceed 1 seconds for control / feedback.
- 3.8.3. Serial communication to DCS shall be OPC (Data access 2.0), Ethernet based TCP/IP Protocol. Alternatively the serial communication shall be MODBUS protocol on RS 485 network.
- 3.8.4. Data transmitted from PLC to DCS shall include all information necessary for the DCS graphic displays to monitor and control the process equipment and PLC. Such data may include pertinent analog and digital status information, interlock, alarms and maintenance conditions. Data transmitted from DCS to the PLC shall include necessary signals to provide operator control interface from DCS for the process/equipment being controlled by PLC.
- 3.8.5. Bidder to include 'Light interface units, converters, Ethernet switch, accessories at PLC end for connectivity to other system. The bidder's terminal point shall be Ethernet port in case of copper medium connection to DCS or LIU in case of Fiber optic medium for connectivity with plant DCS. In case distance between PLC & DCS is greater than 1.8 Km, single mode of optical fiber cable with compatible accessories shall be used. For distance less than 1.8 Km multimode optical fiber ports shall be used.

### 3.9. POWER SUPPLY Scheme

- 3.9.1. PLC Panel and I/O Cabinets: PLC system shall be provided with 2x100% UPS fed from Two Nos. redundant 415V, 3-ph feeders, ~~as per the scheme PE SD 999-145-001, sh-08 of 08. Each UPS shall have 30 minutes back up.~~ Input feeder failure shall be monitored in the PLC system. Necessary redundant power pack and transformers shall be provided (in the PLC panel) to derive the power supply for control desk, PLC panel and input / output cabinets etc
- 3.9.2. Remote I/O panels: Similar power supply arrangement as for PLC panels shall be provided if it is not possible to extend the power cable form UPS of PLC panels.
- 3.9.3. Each OWS and associated HMI peripherals shall be provided with a feeder from either one of the UPS

## 4. DRAWING/DOCUMENT AND DATA TO BE FURNISHED AFTER AWARD OF THE CONTRACT:

### 4.1. For Approval:

- PLC system configuration drawing along with functional write-up.
- Input/Output signal list.
- BOM of PLC
- List of PLC controlled devices
- Control panel/control desk GA drawings.
- Control desk/panel component layout drawing.
- Control panel/control desk Foundation detail and cutout drawings
- ~~Power distribution scheme.~~

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- Block logic diagrams.
- Annunciation list.
- PLC control room layout drawing.
- List of soft signal exchange with Plant DCS.
- List of mandatory spares
- Quality plan
- Data Sheet-C
- CRT display
- Power supply scheme for PLC system, HMI & peripherals, Remote I/O etc.

#### 4.2. For Information:

- Cable schedule and cable interconnection drawing( in BHEL approved format)
  - Between Field and PLC
  - Between Field and MCC
  - Between MCC and PLC
- Electronic earthing requirements.
- Panel Heat dissipation data
- Product/component catalogues.
- Operation & Maintenance Manual on CDs.
- Softcopy of Final/As-built drawings on CDs.
- Calculation for Processor, Memory & Data bus loading

The above list is the minimum requirements. Additional documents/calculations required shall be finalized during contract stage.

### 5. DRAWINGS AND DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID

- Proposed PLC system configuration drawing with write-up
- Product catalogues and specifications for PLC as well as HMI application.
- Proposed power supply schemes for PLC system, peripherals, and Remote I/O panels.

### 6. TESTING AND INSPECTION

- 6.1. The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.
- 6.2. BHEL's standard Quality Plan for PLC is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.
- 6.3. The complete PLC system, including all instrument and devices shall be subjected to standard factory tests (i.e. Type Tests and Routine Tests) as per relevant NEMA, IEEE, IEC.
- 6.4. Factory Acceptance Test-FAT (Functional Tests) shall be performed prior to shipment and Owner/Purchaser shall be notified 15 days before the schedules dates of the test.
- 6.5. The certificates for following type tests, as per IEC Standard, shall be submitted: -
  - Surge protection test as per IEC-225-4
  - Dry heat test as per IEC-68-2-2
  - Damp Heat test as per IEC-68-2-3

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- Vibration Heat test as per IEC-68-2-6
- Electrostatic discharge test as per IEC-801-2 or equivalent
- Radio frequency Immunity test as per IEC-801-6 or equivalent
- Electromagnetic Immunity test as per IEC-801-3 or equivalent

## 7. SPARES AND CONSUMABLES

### 7.1. Commissioning Spares and consumables

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

### 7.2. Mandatory Spares

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

### 7.3. Recommended Spares

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

### 7.4. Special Tools & Tackles

The bidder shall supply all Special Tools & Tackles 'as required' during Start-up and further maintenance of the system, as part of the main equipment supply.

### 7.5. Spares, Service support

Bidder shall provide availability of spares and service support for minimum 10 years after guarantee period.

## 8. MARKING AND PACKING

### 8.1. Marking:

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag/serial Number and salient technical specification.

### 8.2. Packing:

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain, moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in transit and storage in open.

## 9. PERFORMANCE AND GUARANTEE