

**Telangana State Power Generation Corporation Ltd.  
1x800 MW Kothagudem TPS**

**EPC Bid Document  
e-PCT/TS/K/02/2014-15**

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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

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**DEVELOPMENT CONSULTANTS  
(PCT-K-03-2013-14\_V-VI\_S VII\_SS A.DOC)**

**V VI/S-VII/SS-A: 43**

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- 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

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|------------------------|---|--|
| 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                       |

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|-----|------------------------|---|--|
| 9.  | Cold end sealing       | : | SS pot weal with colour coded PTFE headed sleeve insulated flexible tails.<br>Sealing compound Epoxy resin |
| 10. | Minimum bending radius | : | 30 mm  |
| 11. | Length of T/C          | : | 30 Mtr. (minimum)  |

*Notes:*

The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, type of thermocouples shall be K-type.

6.00.00 **FLOW ELEMENTS**

6.01.00 ORIFICE PLATE

6.01.01 The orifice plate shall be either concentric square edge type or segmental bored type as per type of process .

6.01.02 Manufacturing, installation and use will be in accordance to the standard BS1042.

6.01.03 Orifice plates will be made of type 316 stainless steel.

6.01.04 The plate thickness of the orifice shall be 3 mm minimum. However the orifice thickness shall be determined by the actual process parameter.

ORIFICE FLANGE

6.01.05 Orifice flange rating will be the same as the piping class.

6.01.06 Flange shall be Standard / Slip on / socket weld/ weld neck raised face as per ANSI B 16.5

6.01.07 Gasket shall be CAF type depend on application.

CARRIER RING

6.01.08 Male female carrier ring of SS316 material shall be provided.

- 6.01.09 Beyond line size 500 mm, disc type orifice plate will be used.  
PRESSURE TAP
- 6.01.10 Corner taps with Annular Grooves on Carrier Rings as per BS 1042
- 6.01.11 Numbers of tappings as per approved P&IDs of size ½" NPT shall be provided. However, one pair spare tapping shall also be provided with each orifice.  
VENT HOLE/ DRAIN HOLE
- 6.01.12 Suitable Vent hole for water service shall be provided.  
BETA RATIO
- 6.01.13 The ratio of throat diameter to inlet diameter (beta ratio) of the Orifice will be limited between 0.30 and 0.70.  
ACCURACY
- 6.01.13 Accuracy (uncertainties on discharge coefficient 'c' ) of flow measurement shall be +/-1% for orifice plates according to BS 1042 except for critical measurement (performance calculation).  
ISOLATION VALVES
- 6.01.14 Each tapping point shall be equipped with one primary isolating valve for low pressure and two primary isolating valves for high pressure installations (greater than 40 bar and/or 450 deg c).
- 6.01.15 Material of isolating valve shall be SS316
- 6.01.16 ½ inch NPT (M) SS316 Nipples shall be used to interface valve with orifice.  
NUTS/BOLTS/ GASKETS
- 6.01.17 Jack bolt shall be provided for easier removal.
- 6.01.18 Studs and nuts material shall be ASTM A193 Gr. B7 / A194 Gr. 2H  
TAGGING
- 6.01.19 Orifice plate will be provided with a Handle. Tag number, orifice plate material, measured bore and id of the pipe will be stamped or deep engraved on the upstream face of the Handle.

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- 6.02.00 FLOW NOZZLE
- 6.02.01 The Flow Nozzle shall be ASME long radius type.
- 6.02.02 Manufacturing, installation and use will be in accordance to the standard ASME PTC CODE 19.5.
- 6.02.03 Nozzle shall be made of Forged 316 stainless steel.
- 6.02.04 Nozzle shall be machined on latest CNC machines to ensure accuracy.
- END CONNECTION
- 6.02.05 End connection shall be Butt Welded.
- BRANCH PIPE
- 6.02.06 Branch pipe material shall be of same process pipe material.
- 6.02.07 Length of the branch pipe shall be minm. 4D upstream and 2D downstream.
- 6.02.08 Branch pipe assemblies shall be properly machined to acquire required smoothness
- TAPPINGS
- 6.02.09 D & D/2 tapping on pipe shall be provided.
- 6.02.10 Tapping size shall be of 15 NB and number of tappings shall be as per approved PID. However, one pair of spare tapping for each element shall also be provided for each nozzle.
- BETA RATIO
- 6.02.11 Beta ratio shall be limited between 0.30 and 0.70.
- ACCURACY
- 6.02.12 Accuracy ( uncertainties on discharge coefficient ) of measuring flow measurement shall be equal or better +/-2 % except for critical measurement ( Performance calculation)
- ISOLATION VALVES

- 
- 6.02.13 Each tapping point shall be equipped with one primary isolating valve for low pressure and two primary isolating valves for high pressure installations (greater than 40 bar and/or 450 deg c).
- 6.02.14 Material and size of SW isolating valve shall be SS316 and 15 NB respectively.
- 6.02.15 Suitable Nipples and adaptors shall be used to interface valve with Flow Nozzle .
- TAGGING
- 6.02.16 Nozzle tag no. , material, id , Flow direction will be stamped
- TEST & EXAMINATION
- 6.02.17 All orifices and Flow Nozzles shall be tested in accordance with the quality assurance programme, which shall meet the requirements of applicable codes.
- 6.02.18 Instruments offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar product shall be furnished. Routine tests, Acceptance tests and all special tests (if any) shall be carried out for all the instruments as per quality plan and applicable standards.
- 6.02.19 Calibration shall be done in reputed laboratory like IIT.
- 6.02.20 IBR certification shall be provided wherever the process pipes come under IBR regulation.
- 6.02.21 The type, routine & acceptance tests shall be witnessed by Inspection agency as per requirements given by the quality plan. Contractors shall give at least 15 days advance notice for witnessing the test. Copies of the certified reports of all tests carried out at the works should be furnished. The equipments shall be dispatched from works, only after receipt of purchasers' written approval of the test reports.
- Certified reports of all the tests carried out at the works shall be furnished for approval of Owner. Test reports shall be completed with all details and also contain specified limiting values, wherever applicable, to facilitate review. The instruments shall be dispatched from works only after receiving the owner's approval of the test reports. The bidders shall have to carry out all the tests within his quoted price and no extra payment can be claimed by bidders.
- 6.03.00 AEROFOIL

6.03.01 For airflow measurement, flow sensing element shall be aerofoil (steel) with ½” tappings.

#### 7.00.00 CHP RELATED SPECIAL INSTRUMENTS

Technical specifications for some of the special instruments required for Coal Handling Plant are enumerated below.

##### 7.01.00 ZERO SPEED SWITCHES

It shall be provided for all belt drives or indirectly driven equipment and shall be two-wire, inductive, proximity type. The probe housed in robust stainless steel enclosure of protection class IP 65 shall be installed either radially or axially. Sensing distance range shall be 1 to 25mm. The converter unit shall be dust & water tight, corrosion resistant and shall be mounted separately. The interconnecting cable length shall not be less than 3 meters. Following features shall be provided.

- |                           |   |  |
|---------------------------|---|--|
| a) Speed setting accuracy | : | Within $\pm 2\%$ of desired value.   |
| b) Repeatability          | : | Within $\pm 0.1\%$ .   |
| c) Differential           | : | Within $\pm 5\%$ of set value  |
| d) Contacts               | : | 2 C/O  |
| e) Preferred features     | : | (i) Red LED for “Supply On”<br>(ii) Green LED for “Relay On”<br>(iii) Display of present speed<br>(iv) Display of speed set<br>(v) Alarm facility with<br>indication<br>(vi) Initial bypass time delay |

##### 7.02.00 BELT SWAY SWITCHES

Auto reset type in IP 65 class enclosure shall be provided (in pairs) for protecting all non-self-aligning conveyor belts and can be installed in vertical or horizontal position at no more than 30 Mtr. Intervals. For any conveyor, however, minimum two pairs of switches shall be provided.

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**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 Material 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.

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5.01.00 Alarms shall be available in the local monitor in the dry room for each unit covering the entire SWAS system, with repeat facility in DDCMIS.

6.00.00 **ANALYZERS**

All Analyzers shall be of microprocessor based design. The general technical specification of the analyzers is provided in this section. Bidder in his offer shall indicate the sample flow requirement of each analyzer and the total quantity of cooling water required for the system.

6.01.00 **CONDUCTIVITY ANALYZER**

**A. Sensor**

1. Type of Cell : Flow thru'
2. Conductivity Range : As per process
3. Cell Constant : 0.01 / 0.1 / 1.0 depeding upon range
4. Temp. Compensation : Manual and Automatic (Integral) 0-100°C
5. Process Connection : Screwed
6. Wetted Parts : Electrodes-SS 316L/ Insulators KYNAR/ Viton
7. Pressure Rating : 10 kg/cm<sup>2</sup>
8. Accessories : Vessel (SS 316) with ½" NPT connection
9. Cable : Upto transmitter in flexible conduct

**B. Transmitter**

1. Type : Microprocessor based, Single stream
2. Mounting : 2" pipe
3. Protection Class : IP-65 or better
4. Output : 4-20 mA DC (isolated)
5. Display : Digital Display in Engineering Unit, Alarm Status.
6. Zero/Span Adjustment : Front Panel Membrane type Keyboard

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| 7.  | Temp. Compensation | : | Automatic  |
| 8.  | Diagnostic         | : | Self diagnostic for electronics, electrode etc   |
| 9.  | Alarm              | : | Dual set point, hysteresis and time delay adjustable   |
| 10. | Enclosure          | : | Die cast aluminum, epoxy coated  |
| 11. | Cable Termination  | : | Internal (cable entry through conduit)   |
| 12. | Accuracy           | : | $\pm 1.0$ % of measured range  |
| 13. | Response time      | : | Less than 5 sec  |
| 14. | Stability          | : | $\pm 1.0$ % of output range / month non-cumulative   |
| 15. | Accessories        | : | <p>a.2" pipe mounting bracket, Sensor cable with flexible conduit ( as required), ½" NPT Cable Gland, SS Tag plate, For cation conductivity- Dual Ion-Exchange column, resin, etc. (minimum 12 months' requirements).</p> <p>b. Retractable type conductivity sensor along with flow chamber and other accessories shall be provided for vacuum application. Transmitter (local) along with 4-20 Ma output to SWAS room &amp; DDCMIS shall also be provided.</p> |

**6.02.00 pH ANALYZER**

**A. Sensor**

- |    |                     |   |   |
|----|---------------------|---|---|
| 1. | Type of Cell        | : | Flow thru'                              |
| 2. | Range               | : | 0-14 pH                                 |
| 3. | Type of measurement | : | Combination electrode                   |
| 4. | Temp. Compensation  | : | Manual and Automatic (Integral) 0-100°C |
| 5. | Process Connection  | : | Screwed                                 |

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|-----|---------------------|---|---|
| 6.  | Measuring Electrode | : | Glass, high independence, thin electrode in one housing |
| 7.  | Pressure Rating     | : | 10 kg/cm <sup>2</sup>                                   |
| 8.  | Accessories         | : | Vessel (SS 316) with ½" NPT connection                  |
| 9.  | Cable               | : | Upto transmitter in flexible conduct                    |
| 10. | Preamplifier        | : | Integral or separate                                    |
| 11. | Liquid Junction     | : | Ceramic / Kyner or equivalent                           |

**B. Transmitter**

- |     |                    |   |   |
|-----|--------------------|---|---|
| 1.  | Type               | : | Microprocessor based, Single stream   |
| 2.  | Mounting           | : | 2" pipe   |
| 3.  | Protection Class   | : | IP-65 or better   |
| 4.  | Output             | : | 4-20 mA DC (isolated)   |
| 5.  | Display            | : | Digital Display in Engineering Unit, Alarm Status.                                      |
| 6.  | Accuracy           | : | ± 0.2% of FSD or better   |
| 7.  | Response time      | : | Less than 5 sec   |
| 8.  | Stability          | : | ± 0.001 pH /week  |
| 9.  | Repeatability      | : | ± 1% or better  |
| 10. | Temp. Compensation | : | Automatic (Pt-100 sensor)   |
| 11. | Diagnostic         | : | Self diagnostic for "Calibration required"/ "Calibration O.K.", electrode checking etc. |
| 12. | Alarm              | : | Dual set point, hysteresis and time delay adjustable                                    |
| 13. | Enclosure          | : | Die cast aluminum, epoxy coated   |
| 14. | Cable Termination  | : | Internal (cable entry through conduit)  |
| 15. | Accessories        | : | 2" pipe mounting bracket, Sensor cable  |

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**V VI/S-VI/SS-M: 10**

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1x800 MW Kothagudem TPS

EPC Bid Document  
e-PCT/TS/K/02/2014-15

with flexible conduit ( as required), ½”  
NPT Cable Gland, SS Tag plate, ,  
Ultrasonic Electrode Cleaner, Buffer  
solution tablets

6.03.00

**SILICA ANALYZER**

1. Type : Colorimetric monitor, gravity / pumped feed Microprocessor based
2. No. of Streams : Multi-stream with atleast one stream as spare
3. Output : 4-20 mA DC (isolated) into 600 ohms
4. Readout : Digital Indicating meter for direct readout
5. Accuracy : ± 1% of F.S.D or better
6. Reproducibility : ± 2% of F.S.D. or better
7. Calibration : Manual & automatic
8. Cycle time : Less than 10 min or better
9. Operating temperature : 0-50 ° C
10. Temperature Compensation : (Pt-100 Sensor)
11. Mounting : 2” pipe
12. Life of light source : 10,000 hours (approx.)
13. Alarm Facility : 2 HI & 2 LO independently adj. over span.
14. Enclosure Protection : IP-65
15. Accessories : Reagent cabinet , Sample strainer, Reagent Reservoir etc., Phenolic name plate, Reagents & consumables, Special cables.

6.04.00

**SODIUM ANALYZER ASSEMBLY**

1. Type of Cell : Flow Through ion-selection electrode
2. Flow Chamber : Plexi Glass Body or equivalent

DEVELOPMENT CONSULTANTS  
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**Telangana State Power Generation Corporation Ltd.  
1x800 MW Kothagudem TPS**

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- |     |                      |   |  |
|-----|----------------------|---|--|
| 3.  | Measuring Electrode  | : | Sodium Selective Glass Electrode   |
| 4.  | Output               | : | 4-20 mA DC (isolated) into 600 ohms  |
| 5.  | Temp. Compensation   | : | Automatic upto 45 deg.C  |
| 6.  | Read Out             | : | Digital Indicating meter   |
| 7.  | Accuracy             | : | < 5% of reading  |
| 8.  | Response Time        | : | 2 minutes or better  |
| 9.  | Mounting             | : | Flush Panel  |
| 10. | Calibration          | : | Automatic  |
| 11. | Alarm Facility       | : | 2 HI and 2 LO independently adj. over span.  |
| 12. | Enclosure Protection | : | IP-65 or better  |
| 13. | Accessories          | : | Phenolic tag plate, Sample filter, Pressure regulator & flow meter, Automatic calibration kit, Reagents and consumables, Special cables, ½" NPT cable gland. |

**6.05.00 HYDRAZINE ANALYZER**

- |     |                    |   |  |
|-----|--------------------|---|--|
| 1.  | Type               | : | Electrochemical                            |
| 2.  | Output             | : | 4-20 mA DC linear                          |
| 3.  | Readout            | : | Digital Indicating Meter, linear read-out  |
| 4.  | Accuracy           | : | ± 2% of FSD or better                      |
| 5.  | Reproducibility    | : | 2% of FSD or better                        |
| 6.  | Drift              | : | 2 ppb/month or better                      |
| 7.  | Temp. Compensation | : | Automatic up to 45 ° C                     |
| 8.  | Response Time      | : | 1 minutes or better                        |
| 9.  | Mounting           | : | Flush Panel                                |
| 10. | Alarm Facility     | : | 2 HI and 2 LO independently adj. over span |

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- |     |                      |   |  |
|-----|----------------------|---|--|
| 11. | Preferred Feature    | : | 2 Hi and LO alarm LED visible from front , Power supply on/failure LED   |
| 12. | Enclosure Protection | : | IP-65/ NEMA 4 or better  |
| 13. | Accessories          | : | Sample Conditioning kit, Phenolic nameplate, Special cable upto transmitter with flexible conduit Chemical reagents for 12 months, . ½” NPT Cable Glands |

**6.06.00 DISSOLVED OXYGEN ANALYZER**

- |     |                      |   |   |
|-----|----------------------|---|---|
| 1.  | Type                 | : | Electro-chemical, Microprocessor based.   |
| 2.  | Range                | : | As per process.   |
| 3.  | Type of Cell         | : | Flow through sampling type (continuous)   |
| 4.  | Enclosure            | : | IP-65 or better   |
| 5.  | Output               | : | 4-20 mA DC isolated to a load of 600 Ohms (minimum)   |
| 6.  | Temp.Compensation    | : | Automatic up to 45°C  |
| 7.  | Readout              | : | Digital Indicating meter  |
| 8.  | Accuracy             | : | Better than $\pm 2\%$ of full scale for Transmitter   |
| 9.  | Sensor Response Time | : | 90% in 30 seconds or better   |
| 10. | Mounting             | : | Flush panel   |
| 11. | Alarm Facility       | : | 2 HI & 2 LO independently adj. over span.   |
| 12. | Preferred Feature    | : | HI & LO Alarm LED visible from front, Power supply on/failure LED, In-built calibration facility. |
| 13. | Accessories          | : | Phenolic nameplate, Special cable upto transmitter with flexible conduit, ½” NPT Cable Glands     |

**6.07.00 CHLORIDE ANALYZER**

- |    |      |   |   |
|----|------|---|---|
| 1. | Type | : | Electro-chemical, Microprocessor based. |
|----|------|---|---|

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- |     |                     |   |  |
|-----|---------------------|---|--|
| 2.  | Type of cell        | : | Chloride ion selective electrode   |
| 3.  | Enclosure           | : | IP-65 or better  |
| 4.  | Output              | : | 4-20 mA DC isolated to a load of 600 Ohms (minimum)  |
| 5.  | Temp.Compensation   | : | Automatic with Pt 100  |
| 6.  | Ambient temperature | : | 45°C   |
| 7.  | Readout             | : | Digital Indicating meter   |
| 8.  | Accuracy            | : | Better than $\pm 2\%$  |
| 9.  | Reproducibility     | : | <3%  |
| 10. | Detection limit     | : | 0.5 mg/ L or better  |
| 11. | Analysis time       | : | 5 minutes ( max).  |
| 12. | Cycle time          | : | Adjustable   |
| 13. | Calibration         | : | Manual or automatic  |
| 14. | Mounting            | : | Flush panel  |
| 15. | Alarm               | : | 1 HI, 1 LO & 1 system alarm  |
| 16. | Control accessories | : | Sample level detector, Reagent level detector, Calibration solution level detector, Automatic sample, rinse and drain valve, Pump for calibration solution, Pump for reagent solution. |
| 17. | Accessories         | : | Reagent solution tank, Calibration solution tank   |

**6.08.00 TURBIDITY ANALYZER**

- |    |           |   |   |
|----|-----------|---|---|
| 1. | Type      | : | Nephelometric ( Light reflection principle) |
| 2. | Range     | : | 0.001-100 NTU                               |
| 3. | Body      | : | Corrosion resistant polystyrene             |
| 4. | Enclosure | : | IP-65 or better                             |

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- |    |               |   |  |
|----|---------------|---|--|
| 5. | Output        | : | 4-20 mA DC isolated to a load of 600 Ohms (minimum)  |
| 6. | Readout       | : | LCD Display  |
| 7. | Accuracy      | : | Better than $\pm 2\%$ of full scale  |
| 8. | Repeatability | : | $\pm 1\%$ of reading or $\pm 0.002$ NTU (which ever is greater)  |
| 9. | Accessories   | : | Phenolic nameplate, Special cable upto transmitter with flexible conduit, $\frac{1}{2}$ " NPT Cable Glands, 2" pipe mounting bracket, Calibration kit & standard solution etc. |

**6.09.00 IRON ANALYZER**

- |    |                       |   |  |
|----|-----------------------|---|--|
| 1. | Type                  | : | Colorimetric   |
| 2. | Range                 | : | 0-100 ppb, 0-2 ppm   |
| 3. | Material              | : | Kynar (Probe), Hastelloy C ( Reflector)                              |
| 4. | Enclosure             | : | IP-65 or better  |
| 5. | Output                | : | 4-20 mA DC isolated to a load of 600 Ohms (minimum), 2NO+NC Contacts |
| 6. | Readout               | : | LCD Display  |
| 7. | Operating Temperature | : | 45 Deg. C  |
| 8. | Accessories           | : | As required.   |

**6.10.00 SAMPLE CONDITIONING SYSTEM**

Sample conditioning system shall be designed and constructed to receive and condition all samples as required by the respective analyzers. This shall include all conditioning equipment mentioned herein:

- a) Sample filtering
- b) Primary and final sample cooling and temperature control
- c) Pressure reduction and control, as required
- d) Flow rate control
- e) Pressure and Temperature Protection

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**V VI/S-VI/SS-M: 15**



Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X800 MW KOTHAGUDEM**

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 10.03.2015

SHEET

OF

# Instrumentation Quality Plan



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

## CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks	
				M	C	B		
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V		
	1.1 MODEL NO/TAG NO							
	1.2 RANGE							
	1.3 END CONN							
	1.4 NO. OF CONTACT							
2	CALIBRATION				P	V	V	
	2.1 REPEATABILITY							
	2.2 SET POINT ADJUSTMENT							
	2.3 DIFFERENTIAL							
3	OVER PR & LEAK TEST				P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V		
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V		
	5.1 SENSOR							
	5.2 MOVEMENT							
	5.3 PROCESS CONNECTION							
	5.4 HOUSING							
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V		
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V		

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

**Note :**

- Quantum of check shall be as below :  
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and the same alongwith test certificates to be verified by BHEL



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

## CHECK LIST FOR TRANSMITTER

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

**Legend :**

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

**Note :**

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



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

## CHECK LIST FOR PRESSURE &amp; DP GAUGE

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

**Legend :**

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

**Note :**

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



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

## CHECK LIST FOR LEVEL GAUGE

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

**Legend :**

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

**Note :**

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



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

## CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

**Legend :**

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

**Note :**

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



Technical specification for  
**CONTROL & INSTRUMENTATION**

**1X800 MW KOTHAGUDEM**

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 10.03.2015

SHEET OF

**LCP and JUNCTION BOXES  
SPECIFICATION**

- 1.00.00      **GENERAL REQUIREMENT**
- 1.01.00      ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT
- 1.01.01      All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.
- 1.02.00      SURFACE PREPARATION & PAINTING
- 1.02.01      All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.
- 1.02.02      Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.
- 1.02.03      Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:
- Exterior – Opaline green shade 275 of IS: 5 or equivalent international code..
  - Interior - Brilliant White.
- 1.02.04      Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.
- 1.03.00      WIRING
- 1.03.01      All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.
- 1.03.02      Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.
- 1.03.03      All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

- 1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.
- 1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices
- 1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- 1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.
- 1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.
- 1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- 1.03.10 Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.
- 1.03.11 Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue failure of the conductor.
- 1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation color-coding identified on drawings or by printed wiring lists.

- 1.04.00 TERMINAL BLOCKS
- 1.04.01 All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.
- 1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.
- 1.04.03 The characteristics of the terminal blocks shall be as follows.
- i) High contact force, independent of conductor cross-section and large contact surface area.
  - ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
  - iii) Inspection and maintenance free (resistant to thermal aging and vibration)
  - iv) Low and constant voltage drop
- 1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.
- 1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.
- 1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.
- 1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.
- 1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

- 1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.
- 1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- 1.04.11 Other requirements of the terminal blocks are as follows:
- i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.
  - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
  - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
  - iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
  - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
- 1.05.00 **GROUNDING**
- 1.05.01 Separate Protective and Electronic system ground as required shall be provided.
- 1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.
- 1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground .The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open .The electronic ground between panels of a shipping section shall be firmly looped.
- 2.00.00 **CONTROL DESKS & PANELS**
- 2.01.00 **GENERAL**
- 2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping &

- accessories as required for completeness of the system.
- 2.01.02 The design shall conform to the EN ISO 11064 (Ergonomical design of Control Room), Part 1, 2 and 3.
- 2.01.03 The exact dimensions, material, construction details, grounding, general arrangement etc. shall be as per actual requirement and shall be finalized during detail engineering and subjected to Owner's approval.
- 2.01.04 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 2.01.05 For Control desk/ panel mounted instruments/ devices etc. which are to be powered from UPS, all required conversion of interface equipments/ accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.
- 2.01.06 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 2.01.07 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
  - b) Nameplates for panels shall be provided both in front and rear.
- 2.02.00 CONTROL DESK
- 2.02.01 Control desk shall be free standing, floor mounting, table top type with doors at back and shall be constructed of 3 mm thick (minimum) CRCA steel or Aluminium extrusion. Aluminium structure shall be anodized or powder coated paint finish. The top surface of control desk shall be 30 mm (minimum) thick with the top 12 mm (minimum) of acrylic solid surface and the remaining 18 mm of laminated medium density fibre (MDF) board.
- 2.02.02 Monitors with retractable keyboard shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.
- 2.02.03 Desks shall be of modular, scalable and industrially ruggedized design and shall have connections for PA system handsets & telephone sets.
- 2.02.04 Desks shall have concealed cable trays for wire dressing. Both Horizontal & Side Managers (2 separate horizontal cable routing wire baskets for power & data cables) shall be provided.

Each User station will be provided with 2 separate power distribution units (1 for Main line & 1 for UPS line). Each power distribution unit will have 6 points of 5/13 Amp sockets, Mains MCB On/Off Switch & Indicator.

Adequate heat management provision for Exhaust of heat from within the Console Desk Assembly shall be provided. There will be multiple fans provided in the Main Control Desk. Each Fan will be of 230 VAC 250 CFM Ball Bearing based. Ventilation louvers will be provided on both Front & Rear Modesty with special Air Filters. Adequate space for CPU & Other equipments placed with in the desk.

- 2.02.05 Design shall include Earthing bolts.
- 2.02.06 Back installed items shall be suitably concealed from front view.
- 2.02.07 All operator workstations for SG, TG, Auxiliaries & Off-site Plants shall be mounted on this Control Desk. The cabling / wiring between OWS & CPUs, power supply cables etc. shall be aesthetically routed and concealed from view.
- 2.02.08 **HARDWIRED DEVICES ON CONTROL DESK (DRAW OUT SECTION)**
- Release and Lamp Test push buttons shall be provided for a set of push buttons (decided during detail engineering stage). Depending on the type of control/ function, required number of push buttons/ indicating LEDs & their color, push button stations shall be selected. The size of push button stations shall be 24 x 48 mm or 25 x 50 mm and shall have service inscription details at the front. Emergency push buttons (with cover) shall be mounted on top of Control Desk.
- 2.03.00 **BACK UP PANEL**
- 2.03.01 Construction shall be from CRCA steel of thickness not less than 3mm.
- 2.03.02 Upright back-up panel shall be provided where hardwired devices shall be mounted on a mosaic grid type console. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat & flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.
- 2.03.03 DDCMIS Back-up Panel (referred as Unit Control Panel-UCP) shall also mount annunciation fascia (minimum 500 nos.) and the flame monitoring cameras along with other hardwired devices as decided during detail engineering stage by Owner. Color coding shall also subject to Owner's approval.
- 2.03.04 Colored Mimic for different Off-site plant control systems (as enumerated elsewhere in this specification) and hardwired annunciation system shall also

be mounted on the back up panels.

2.04.00 PANELS/CABINETS

2.04.01 All DDCMIS system modules, power supply components and other Local Control panels (~~PLC/Relay based~~) shall be housed in cabinets as specified below.

2.04.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings prior to shipment to the project site.

2.04.03 The Bidder shall ensure that the cabinets are complete & ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets shall only involve connections through multi-pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/ Back up Panel.

2.04.04 All electronic cards, network components, power supply modules etc. located shall be suitably housed in cabinets and shall be neatly arranged in sub-racks. Network components shall be visible in door closed condition (e.g. Glass doors etc.) as approved by Owner.

2.04.05 Bidder shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate.

2.04.06 The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Cooling Fans shall be provided wherever required and this shall be of industrial grade.

2.04.07 TECHNICAL PARTICULARS

- |    |                          |   |   |
|----|--------------------------|---|---|
| 1. | Material of Construction | : | Cold Rolled Coal Annealed (CRCA) steel sheet  |
| 2. | Thickness of Sheet       | : | a) 2.0 mm for faces supporting instruments / terminals<br>b) 1.6 mm for other sides and top |
| 3. | Construction             | : | Welded throughout as per approved National Standards  |
| 4. | Post welding operation   | : | a) Grounding of all welds to smoothness<br>b) Rounding of corners                           |

- : c) Cleaning of weld spatters
5. Panel height : 2300 mm (approx)
6. Corners : 7 mm inner radius
7. Dimensional Tolerances : a) In height & length - 3 mm  
b) In height between adjacent sections - 2 mm  
c) Total for a group - 6 mm
8. Doors : Double, recessed, turned back edges, full height front & rear
- i) Thickness of Sheet : 2 mm
- ii) Hinges : Stainless steel
- iii) Door latches : Three point type
- iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure
- v) Opening of the doors : Outward
- vi) Louvers : With removable wire mesh to ensure dust and vermin proof
9. Gland plates : Removable in sections  
4 mm thick (bottom)
10. Cable entry : Bottom
11. Hardware : a) Anti vibration pad- 15 mm  
b) Predrilled base channel ISMC – 100 or equivalent for all sides  
c) Stainless steel buff- finished 2 mm thick kick plate for all sides  
d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws  
e) Rubber strips to ensure air

- tightness between kick plate and finished floor
- f) Lifting hook / Eye bolt
- g) Drawing pocket
- h) Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixtures
12. Name Plate : Both at front and back surface of the panel
13. Fixing of name plate : Stainless steel pan head screws
14. Name plate material : Laminated phenolic (3 layers)
15. Lettering : Black with white engraved
16. Mounting of terminal blocks : Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure

## 2.05.00 FURNITURE

All the furnitures in the Central / Local control Room (s), Engineers' rooms, Instrument laboratory , SWAS Room & any other rooms with C&I equipments located in different plant buildings under Bidder's scope shall be included in Bidder's scope of supply. Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe.

## 2.05.01 WORK STATION FURNITURE

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

## 2.05.02 PC RACK

PC Racks shall be provided to mount CPUs of workstations/PCs of OWS/LVS etc. in control room. For each PC / workstation / monitor at least one chair shall be included.

## 2.05.03 CHAIRS

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

2.05.04 TABLES

Industry standard computer tables shall be provided & shall be as approved by Owner during detailed Engineering. Glass top teak wood horse shoe shaped table with vertical file mounting arrangement (two layers to house approx. 40 Nos of files and lockable drawers at both ends) for Engineering Room shall be provided.

2.05.05 ALMIRAHs

Steel Almirahs shall be provided for keeping documents in the documentation room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed Engineering.

2.05.06 KEYPAD

One keypad per unit shall be provided for the storing of keys of relevant areas of the unit in the control room.

2.05.07 LOCKERS

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel. Also, lockers of bigger size shall be provided in documentation Room for storing of personal documents. Details shall be finalized and approved by Employer during detailed engineering.

3.00.00 **LVS PANEL**

3.01.00 An arc shaped Large Video Screen (LVS) panel shall be supplied for mounting large video screens in number of tiers in various Control rooms as specified elsewhere in this specification.

Bidder shall provide and fix ACP cladding around the LVS screen including covering the LVS back side and LVS stand. The cladding will be from floor finish to 600 mm above LVS screen like a self-standing partition with necessary openings for system requirement. ACP paneling shall be with 304 grade & approx. 0.5 mm mirror finish SS strip.

3.02.00 The profile, dimensions and the general arrangement shall be finalized & approved by Owner during detailed engineering. Recommendations, if any, for the control room lighting in order to ensure continuous proper viewing of the LVS screen by the operator & shift incharge (without any fatigue) shall be