

Motors conforming to BS or IEC Publications, which ensure equivalent quality shall also be acceptable. In case of any difference between IS Specification/International Standards (IEC; NEMA etc.), this motor specification prevails.

**1.5 TYPE****1.5.1 AC Motors:**

- a) Squirrel cage induction motor suitable for direct-on-line starting.
- b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg. C ambient temperature), shall be **Efficiency class-IE2**, conforming to IS 12615, or IEC:60034-30.
- c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

1.5.2 DC Motors Shunt wound.

**1.6 VOLTAGE (NOMINAL)****1.6.1 LV Motors**

For motors upto and including 200 KW - Four hundred fifteen (415) V.

**1.6.2 MV MOTORS**

For motors above 200kW upto and including 1500kW, Three point three (3.3) kV.

**For CHP conveyors motor above 160 kW, 3.3 kV, AC supply is to be used. However all the motors on stacker reclaimer shall be on 415 V AC only.**

**1.6.3 HV Motors**

For motors above 1500kW - eleven(11) KV

1.6.4 All motors are to be designed for system grounding described in "System Particulars" under site information of the Driven Equipment Specification.

**1.7 FREQUENCY (NOMINAL) - fifty (50) Hertz**

1.8 NUMBER OF PHASES - Three (3)

1.9 SPEED - As required by the driven equipment

1.10 TYPE OF STARTING :

Direct on-line (VFD/Soft-starter/star/delta starting in special cases)

1.11 DUTY

1.11.1 Continuous motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment,



whichever is higher, considering highest system frequency and voltage variation. Crane motors shall be rated for S4 duty, 40% cyclic duration factor. If however, a higher margin is stipulated in the accompanying driven equipment specification, the higher stipulated margin shall prevail.

1.11.2 All HT motors shall have vibration pads for mounting vibration detectors.

1.11.3 All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes.

1.11.4 Motors shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment atleast twenty five (25) percent above or below, preferably above the motor operating speed (to avoid resonance in vibration over the operating speed) range.

1.11.5 All LV motors rated 0.37kW and higher with S1 duty shall be compulsorily be of energy efficiency level IE 2 as per IS 12615:2011.

Motors rated above 37kW shall have efficiency higher than 0.92 and high power factor of atleast 0.88.

#### 1.12 **SUPPLY VARIATIONS**

Motors shall be capable of running continuously at full load under following variations in power supply:

1.12.1 All equipments shall be suitable for rated frequency of 50 Hz with a variation of (+) 3% and (-)5%, voltage variation of ( $\pm$ ) 6% for 11 kV & 3.3 kV and ( $\pm$ )10% for 415V and 10% (absolute sum) combined variation of voltage and frequency unless specifically brought out in the specification.

#### 1.13 **ABNORMAL CONDITIONS CAPABILITY**

Motor shall have following capabilities as specified design ambient temperature:

1.13.1 The motors shall also be capable of running up again after voltage collapse to about 40% for approximate duration of 0.5 sec. Subsequent rise in voltage to 70% and further to 80% and 100%, the total duration not exceeding 20 sec.

1.13.2 Low Voltage Running :

Motor shall be capable of running satisfactorily at seventy five (75) percent nominal voltage for five (5) minutes.

1.13.3 Momentary Low Voltage Withstanding :

Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.

#### 1.14 **STARTING CAPABILITY**

1.14.1 Low Voltage Starting :

Motor shall be capable of starting and accelerating to full speed at full load (including loaded equipment e.g. mills and conveyors etc) at eighty (80)

percent nominal voltage at motor terminals. Mill motors may be permitted to start with terminal voltage not below 90%.

1.14.2 Cold Motor Starting ..... Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment eg mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.

1.14.3 Hot Motor Starting ..... Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment e.g. mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.

1.14.4 Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.

1.14.5 Break-away Starting Current ..... Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below:

1.14.5.1 Motors above 1500 KW upto 4000kW ..... 600% without any positive tolerance except for ID Fan Motor.

1.14.5.2 Motors above 4000 KW ..... 450%. Not subject to any positive tolerance.

1.14.5.3 For D.C. Motors the starting current shall be limited to 2 times full load current.

#### 1.14.5.3 **Starting voltage requirement**

a) All Motors (except Mill Motors)

- 80% of rated voltage for Motors upto 4000 kW
- 75% of rated voltage for Motors above 4000 kW

b) For Mill Motors:

- 85% of rated voltage for Motors above 1000 kW
- 90% of rated voltage for Motors below 1000 kW

Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.

#### 1.14.5.4 **Starting Time**

1.14.5.4.1 For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.

1.14.5.4.2 For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.

1.14.5.4.3 For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.



1.14.5.5 **Torque Requirements:-**

1.14.5.5.1 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10%. Motor full load torque.

1.14.5.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty Motors.

1.15 **SAFE STALL TIME**

1.15.1 To avoid problem in selecting standard protective relays without using speed switches, safe stall time under hot conditions (corresponding to 110% nominal voltage at motor terminals) shall be more than the accelerating time (corresponding to 80% nominal voltage at motor terminals) by the following minimum values :

1.15.1.01 Two (2) seconds, where accelerating time (at 80% nominal voltage) does not exceed 20 seconds.

1.15.1.02 Three (3) seconds, where accelerating time (at 80% nominal voltage) exceeds 20 seconds.

1.15.1.03 At no stage, speed switch shall be provided to achieve the above requirements mentioned under Clause No. 1.14.5.4

1.16 **CLASS OF INSULATION**

1.16.1 LV Motors ..... Class F.

1.16.2 MV & HV Motors ..... Class F

1.16.03 However temperature rise shall be restricted to limits corresponding to Class 'B' insulation for both HT & LT motors. The temperature under abnormal running conditions shall be limited to 5°C above class 'B' limits.

1.16.04 The value of the polarization index for motors above 200kW should not be less than 2 when determined according to IS: 7816.

1.17 **TEMPERATURE RISE UNDER NORMAL CONDITIONS.....** Temperature rise over specified design ambient temperature when motor is running with full load at nominal supply voltage & frequency shall not exceed the values given below:

| S.No.   | Specified Design Ambient Temperature | Thermometer Method | Resistance Method |
|---------|--------------------------------------|--------------------|-------------------|
| 1.17.01 | 50°C                                 | 60°C               | 70°C              |
| 1.17.02 | 45°C                                 | 65°C               | 75°C              |
| 1.17.03 | 40°C                                 | 70°C               | 80°C              |

**1.18 BUS TRANSFER WITHSTAND CAPABILITY**

Motors will be connected to an automatic bus transfer system and hence may be subjected to one hundred and fifty (150) percent of the nominal voltage during changeover of buses due to the vector difference between the residual voltage and incoming supply voltage and the duration of this condition may be one second. Motors shall be capable of withstanding the voltage and torque stresses developed under such conditions without damage. The manufacturer/vendor shall indicate the special precautions taken to meet the above requirements and confirm.

- 1.18.01 That about 5000 bus transfers, in lifetime of motor, shall not puncture its insulation.
- 1.18.02 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.
- 1.18.03 That the motor windings shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.
- 1.18.04 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

**1.19 TYPE OF ENCLOSURE**

- 1.19.01 Outdoor Motors ..... IP 55 (Additional canopy to be provided by EPC contractor.
- 1.19.02 Indoor Motors ..... IP 55
- 1.19.03 IP-55 degree of protection shall be achieved without application of any compound, putty etc.
- 1.19.04 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv. as detailed below:
- a) Fuel Oil area : Group IIB
  - b) Hydrogen generation plant area : Group IIC (or Group-I, Div-II as per NEC or Class-1, Gr-B, Div-II as per NEMA/IEC60034).

**1.20 METHOD OF COOLING**

- 1.20.1 Method of cooling shall be IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA). However, motors rated 3000kW or above can be closed air circuit water cooled (CACW).
- 1.20.2 Large capacity motors not available with above types of cooling may be accepted with IC 81 W for IC 91 W (CACW) cooling subject to the approval of the Owner.

**1.21 TYPE OF MOUNTING ..... As required for the driven equipment.****1.21 MAXIMUM MECHANICAL VIBRATIONS**

- 1.21.01 Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits



prescribed in IS: 12075 / IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.

1.21.02 Noise level

The noise level of motors shall not exceed 85 db (A) at 1m from operating motor measured in accordance with IS: 10265.

1.21.03 Motor body shall have two earthing points on opposite sides.

1.21.04 11 KV motors shall be offered with Separate Insulated Connector (Elastimould or Equivalent make) as per IEEE 386. The offered Elastimould terminations shall be provided with protective cover and trifurcating sleeves. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.

1.21.05 3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

1.21.06 The spacing between gland plate & centre of terminal stud shall be as per Table-I.

**TABLE - I**

**DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS**

| <b>Motor MCR in KW</b>    | <b>Minimum distance between centre of stud and gland plate in mm</b> |
|---------------------------|----------------------------------------------------------------------|
| <b>UP to 3 KW</b>         | <b>As per manufacturer's practice.</b>                               |
| Above 3 KW - upto 7 KW    | 85                                                                   |
| Above 7 KW - upto 13 KW   | 115                                                                  |
| Above 13 KW - upto 24 KW  | 167                                                                  |
| Above 24 KW - upto 37 KW  | 196                                                                  |
| Above 37 KW - upto 55 KW  | 249                                                                  |
| Above 55 KW - upto 90 KW  | 277                                                                  |
| Above 90 KW - upto 125 KW | 331                                                                  |

Above 125 KW-upto 200 KW 203

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

1.21.07 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

1.21.08 For motors rated 1500 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

1.21.09 The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.

|     |                            |   |          |
|-----|----------------------------|---|----------|
| (a) | Below 110KW                | : | 10.0     |
| (b) | From 110 KW & upto 200 KW  | : | 9.0      |
| (c) | Above 200 KW & upto 1000KW | : | 10.0     |
| (d) | From 1001KW & upto 4000KW  | : | 9.0      |
| (e) | Above 4000KW               | : | 6 to 6.5 |

## 1.22 WINDING & INSULATION

- (a) Type : Non-hygroscopic, oil resistant, flame resistant
- (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature.
- (c) 11kV & 3.3 kV : Thermal class 155 (F) insulation.  
AC motors  
The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15
- (d) 240VAC, 415V : Thermal Class( B ) or better  
AC & 220V  
DC motors

## 1.23 DIRECTION OF ROTATION

1.23.1 As needed by driven equipment.

1.23.2 The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

1.23.3 If, in the case of HT motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.

## 1.24 BEARINGS



1 x 660 MW – Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



- 1.24.1 General ..... Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 20,000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.
- Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.
- If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.
- Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.
- For MV & HV motors, the bearings shall be insulated wherever necessary to prevent damage to motor bearings from shaft current.
- When pressure oiling is required for horizontal motors, bearings shall be sleeve type arranged for pressure oiling supplied from lubrication system of driven machine, with ring oiling for starting and emergency duty. Ring oiling system shall be adequate for starting and continuous operation of motor for at least half an hour, without pressure oiling system in operation. Oil sight flow gauges shall be provided to indicate oil flow through each bearing.
- Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.
- Sleeve bearings for use with motors having flexible coupling with limited end play, shall have adequate axial end play to prevent transmission of thrust from driven equipment to motor bearings.
- Bearings shall be of reputed make subject to the approval of the Owner/Consulting Engineer.
- 1.24.2 Large motors ..... Large motors shall preferably have spherically seated babitted, ring forced, feed lubricated, water-cooled bearings. If anti-friction bearings are provided, these shall be roller bearings rated for a minimum standard life of 30000 hours taking all bearing and driven equipment loads into account.
- 1.25 **SHAFT EXTENSION** ..... Key slotted bare shaft extension of required length with key on driving end.
- 1.26 **DRAIN HOLES** ..... Two (2) drain holes with plugs, one (1) on either end of motor at the bottom most point.
- 1.27 **LIFTING DEVICES** ..... Motors shall be provided with eyebolts, lugs or other means to facilitate safe lifting.
- 1.28 **DOWEL PINS**..... It shall be possible to drill holes vertically inclined through motor feet or mounting flange for installing dowel pins after assembling motor and driven equipment, before despatch (for completed driving + driven

equipment assembly) or at site after erection (for separate supplies of above equipment).

1.29 **CENTERING SPIGOT**..... Flange mounted motor shall have centering spigot to match driven equipment socket.

1.30 **EASE OF MAINTENANCE**..... Motor shall be so constructed that it can be de-assembled and reassembled with ease.

1.31 **NAMEPLATES**..... Motor shall have nameplate(s) showing diagram of connections, all particulars as per IS: 325 and following additional information:

In addition, an arrow block shall be screwed on to the body of motor on the non-driving end to indicate direction of rotation of motor.

1.31.1 Temperature rise under normal/abnormal conditions.

1.31.2 Type of bearing and recommended lubricants.

1.32 **FINISH**..... Motor shall have glossy, light grey finish No. 631 as per IS: 5 for withstanding site conditions as per Clause 1.00 above.

All sharp edges and scales shall be removed from the surface, which shall then be thoroughly degreased, de-rusted and given two (2) coats of primer and two (2) coats of finish paint. It is preferred that a phosphate coat is given to motor prior to application of primer coat. Motors for water treatment plant shall have Zinc Chromate base with acid resistant Epilex 4 paint.

1.33 **TERMINAL BOXES**

1.33.1 General .....Motors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight confirming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Owner /Consulting Engineer. All terminal boxes shall be suitable for proper termination of the type and tentative size of cables specified in Clause 1.34 below, however, exact size of cables shall be furnished by Owner during engineering stage.

The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core cables are to be terminated. All HT motors shall be provided with phase segregated terminal box.

Terminal bushings and clamps shall be non-absorbent, non- inflammable, insulated material for connecting with cable.

1.33.2 **Main Terminal Box**



1.33.2.1 LV Motors ..... Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.

1.33.2.2 MV & HV Motors ..... Motor shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. These should be interchangeable to facilitate cable routing.

Neutral terminal box for HT motors rated above 1500 KW shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These transformers shall be supplied and mounted in the motor terminal box. In addition to above, 3 Nos. of identical current transformers shall be supplied loose for mounting in the switchgear. Stator phase terminal box may either be phase segregated or standard terminal box suitable for both top and bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable or push on type terminating Kit. Terminal leading shall be stud type or leading wire type.

1.33.2.3 Cable End Boxes.....Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables of sizes as specified in Clause 1.34 below.

Cable box shall be suitable for glanding the cables; and shall have adequate space between cable glands terminating studs to allow suitable bends of cable inside the cable box for all 3 phases of relevant cable sizes specified.

1.33.2.4 The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.

Min. fault level for MV Motors - 40 KA

Min. fault level for LV & HV Motors - 50 KA

1.33.2.5 **PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:**

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

| Motor MCR in KW              | Clearance |
|------------------------------|-----------|
| UP to 110 KW                 | 10mm      |
| Above 110 KW and upto 150 KW | 12.5mm    |
| Above 150 KW                 | 19mm      |

1.33.2.6 Terminal Accessories.....Each terminal end shall be furnished with bimetallic washers, spring washers, nuts and crimp type aluminium (preferably tinned) lugs suitable for cables of sizes as specified in Clause 1.34 below.

1.34 **TYPE AND SIZE OF CABLES**

1.34.1 **Space Heaters**



- 1.34.1.1 For LV Motors: Two point five (2.5) mm<sup>2</sup>, two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).
- 1.34.1.2 For MV & HV Motors: Six (6) mm<sup>2</sup> two core aluminium conductor PVC insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).
- 1.34.2 For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm<sup>2</sup> ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm<sup>2</sup>, ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).
- 1.34.3 Bearing Temperature Indicators - For each indicator, 0.5 mm<sup>2</sup> six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.
- 1.34.4 For Moisture Detectors.....As for space heaters as per Clause 33.01.01 above.
- 1.34.5 **For Main Terminals**

**LT Motors**

1. Three (3) core cables .....Stranded aluminium conductor, XLPE insulated, colour coded, laid up, PVC sheathed, GI wire / strip armoured, FRLS PVC jacketed overall, 650 / 1100V grade, heavy-duty cables as per IS: 1554 (Part-I).
2. Single core cables .....Stranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC jacketed overall, 650 / 1100V grade, heavy duty cable as per IS: 1554 (Part-I).

**HT Motors**

1. Three (3) core cables ..... stranded aluminium conductor, XLPE insulated, screened colour coded, laid up, PVC sheathed, GI wire/strip armoured FRLS PVC jacketed overall, 6.6 KV / 11 KV grade, heavy duty cables as per requirement for unearthed system as per IS: 7098 (Part-II).

The size and no. of cable to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box, cable gland and lugs suitable for the same.

Cable size may be increased in some cases because of large number of cables in under-ground ducts or because of voltage drop consideration. The supplier shall supply with terminal box and cable accessories suitable for higher size of cable at no extra cost.

1.35 **EARTHING**

- 1.35.01 General..... Two (2) grounding terminals one (1) on either side at the bottom suitable for connecting mild steel/GI flat/GI wire grounding conductor, size of grounding conductor shall be decided during detailed engineering.



- 1.35.02 LV Motors.....At each earthing point, two (2) drilled and tapped holes with hexagonal head bolts, plain washers, spring washers and tinned lugs (for motors upto 5.5 KW) for size of conductor specified shall be provided.
- 1.35.03 MV & HV Motors.....Non-corrodible metallic grounding pad shall be welded or brazed at each earthing point. The size of grounding pad shall be 75x65x25 mm. Grounding pad shall have 40 mm apart two (2) drilled and tapped holes with hexagonal head bolts, plain washers and spring washers for size of conductor specified. In addition, one suitable earthing terminal shall be provided inside the stator phase terminal box for earthing metallic shield of XLPE cables.
- 1.36 **EMBEDDED TEMPERATURE DETECTORS**.....HT motor shall be provided with six (6) Nos. duplex resistance temperature detectors (RTDs) embedded in stator winding at locations where high temperatures are expected. In addition one (1) duplex type RTD shall be provided in each bearing. The RTDs shall be 3 wire duplex platinum resistance type having a value of 100 ohms at 0 Deg.C
- 1.37 **BEARINGS TEMPERATURE INDICATORS**..... HT motors shall be provided with dial type two (2) bearing temperature indicators and will have two (2) sets of contacts, each set having 2 NO + 2 NC contacts rated for 5A at 240V AC and 0.5A at 220V DC. One set will be set to operate at lower value to give alarm and other set at a higher value to trip the motor.
- 1.38 **SPACE HEATERS**.....Valve / Damper actuator motors; and Motors above 30 KW shall be provided with one (1) or two (2) space heaters suitable for 240V, 50 Hertz single phase AC supply and of adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation or deterioration of insulation during shut down. Heaters shall be mounted inside the motor in accessible locations so that their removal and replacement is simple. Motors upto 30 kW shall have stator windings suitable for connections to 24V, 50 Hz AC supply for space heating.
- Motors upto 30 kW shall have stator windings suitable for connection to 24V, 50 Hz ac supply for space heating
- The terminals of space heaters shall be brought out to a separate totally enclosed dust proof and weatherproof terminal box.
- 1.39 **HOT AIR TEMPERATURE DETECTOR**
- If the motor is of CACA or CACW enclosure, a thermometer with alarm contracts in hot air circuit shall be provided.
- 1.40 **WATER FLOW INDICATOR**
- If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits.
- 1.41 **MOISTURE DETECTORS**.....Motors with type of cooling 1C 81W or 1C 91 W shall be provided with moisture detectors for raising alarm in the event of water tube failure.

- 1.42 **BED PLATE**.....Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.
- 1.43 **OTHER ACCESSORIES**..... Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.
- 1.44 **TYPE TEST**
- 1.44.01 **HT MOTORS**
- a) The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract.
  - b) The type tests shall be carried out in presence of the Purchaser's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Purchaser's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
  - c) In case the contractor has conducted such specified type test(s) within last five years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Purchaser's for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Purchaser's reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.
  - d) Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Purchaser's either at third party lab or in presence of client representative and submit the reports for approval.
  - e) **LIST OF TYPE TESTS TO BE CONDUCTED**



**The following type tests shall be conducted on each type and rating of HT motor**

- i) No load saturation and loss curves upto approximately 115% of rated voltage
- ii) Measurement of noise at no load.
- iii) Momentary excess torque test (subject to test bed constraint).
- iv) Full load test(subject to test bed constraint)
- v) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

**f) LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of HT motor

- i) Degree of protection test for the enclosure followed by IR, HV and no load run test.
- ii) Terminal box-fault level withstand test for each type of terminal box of HT motors only.
- iii) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15
- iv) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

1.44.02

**LT Motors**

- a) LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Purchaser's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
- b) However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Purchaser's shall conduct all such tests under this contract at no additional cost to the Purchaser either at third party lab or in presence of client representative and submit the reports for approval.

1.44.03

**LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

1 x 660 MW – Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



**The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only**

- i) Measurement of resistance of windings of stator and wound rotor.
- ii) No load test at rated voltage to determine input current power and speed.
- iii) Open circuit voltage ratio of wound rotor motors ( in case of Slip ring motors)
- iv) Full load test to determine efficiency power factor and slip .
- v) Temperature rise test.
- vi) Momentary excess torque test.
- vii) High voltage test.
- viii) Test for vibration severity of motor.
- ix) Test for noise levels of motor(Shall be limited as per clause no 1.21.01 of this section)
- x) Test for degree of protection and
- xi) Over speed test.
- xii) Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

1.44.04 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

**1.45 INFORMATION WITH PROPOSAL**

1.45.1 AC Motor Data Sheet.

1.45.2 Dimension Drawing/Foundation load details of motor and driven equipment.  
1.45.03 Manufacturer's catalogue showing constructional details.

1.46.00 **INFORMATION ON AWARD OF CONTRACT**.....Within six (6) weeks from the date of award of the Contract, following shall be furnished:

1.46.01 Motor Data Sheet.

1.46.02 Certified binding dimension drawing of motor complete with all accessories and fittings specifically showing terminal boxes, terminal spacing and sizes, earthing connections and sizes thereof, mounting details, lifting lugs, final foundation loads and dimensions with tolerances of centering spigot (where needed), shaft extension and key.

1.46.03 Following characteristics curves:

1.46.03.01 Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment.

1.46.03.02 Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage

1.46.03.03 Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.

1.46.03.04 Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.



- 1.46.03.05 Efficiency, power factor, current and speed versus power output curves.
- 1.46.03.06 Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage.
- 1.46.03.07 Negative phase sequence current withstand characteristics.

**1.47 COMMISSIONING CHECK LIST (HT MOTORS)****A PRELIMINARY CHECKS**

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box
6. Checking stator (motor air gap) Check – Grease lubrication (for ball or roller bearing) is adequate if the motor was in storage for very long period replace the grease, by fresh grease after flushing the bearing clean. Excess grease in the bearing (housing ... is overheat of bearings) Check the free rotation of the rotor in decoupled condition. Check the air gap between stator and rotor at four positions 90° apart at driving and non-driving end. Compare the recorded values with factory results. For slip ring motors : with starting resistances.
  - a) Check the variation of resistance
  - b) Check brush lifting and slip ring short.

**B COMMISSIONING CHECKS**

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Measure resistance of motor winding (in case of large motors)
4. Control and interlocks should be checked
5. Motor protection relay to be calibrated
6. Phase sequence and direction of rotation
7. Other than DOL scheme to be checked example trafo starts
9. Measure starting current starting timer and no load current
10. On load operations starting and running currents (observed vibrations, temperatures of bearings and body)
11. On load operation, starting and running currents (observed vibrations, temperatures of bearings and body)
12. In case of forced water cooling of start or check winding temperatures as ready by built in RTDs.
13. Water level (start up cooling) low to be checked for limit switch operation.



**1.48 COMMISSIONING CHECK LIST (LT MOTORS)****A PRELIMINARY CHECKS**

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box

**B COMMISSIONING CHECKS**

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Over load and short circuit relay tests and settings
4. Control and interlocks should be checked
5. Phase sequence and direction of rotation
6. Operation of timer in case of star delta starting
7. Measure starting current starting timer and no load current
8. On load operations starting and running currents

**1.49 DC MOTOR SPECIFICATION**

DC Motor will be of continuous duty type totally enclosed fan cooled (TEFC) having IP-54 degree of protection suitable for 220 V DC supply. DC motor will be shunt wound type having high torque characteristic suitable for Bi-directional rotation at rated speed and output. The general constructional features and details of DC motor will be in line with details/ particulars stipulated in the specification for AC squirrel cage induction motors.

Contractor will furnish the data in respect of DC motors.

## DATASHEET

|                                                                                                                                                                                                                                            |                                              |                                                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------|
|                                                                                                                                                                                                                                            | <b>Auxiliary power supply</b>                |                                                            |
| <b>1.1</b>                                                                                                                                                                                                                                 | <b>HV supply</b>                             |                                                            |
|                                                                                                                                                                                                                                            | 11kV, 3Φ, 3W, 50 Hz non effectively earthed  | Motors rated above 1500 kW                                 |
|                                                                                                                                                                                                                                            | Fault level                                  | 50 kA for 1 second                                         |
| <b>1.2</b>                                                                                                                                                                                                                                 | <b>MV supply</b>                             |                                                            |
|                                                                                                                                                                                                                                            | 3.3kV, 3Φ, 3W, 50 Hz non effectively earthed | Motors above 200kW upto and including 1500kW               |
|                                                                                                                                                                                                                                            | Fault level                                  | 40 kA for 1 second                                         |
| <b>1.3</b>                                                                                                                                                                                                                                 | <b>LV supply</b>                             |                                                            |
|                                                                                                                                                                                                                                            | 415V, 3Φ, 3W, 50 Hz effectively earthed      | Motors below and including 200kW                           |
|                                                                                                                                                                                                                                            | Fault level                                  | 50kA for 1 second                                          |
|                                                                                                                                                                                                                                            | 110V, 1Φ, 2W, 50 Hz effectively earthed      | Lighting, space heating, AC control and protective devices |
| <b>1.4</b>                                                                                                                                                                                                                                 | <b>DC supply</b>                             |                                                            |
|                                                                                                                                                                                                                                            | 220V, 2W, unearthed                          | DC alarm, control and protective devices.                  |
|                                                                                                                                                                                                                                            | Fault level                                  | 25 kA for 1 second                                         |
| <b>2</b>                                                                                                                                                                                                                                   | Range of variation                           | As indicated in the specification                          |
| <b>2.1</b>                                                                                                                                                                                                                                 | AC supply                                    |                                                            |
|                                                                                                                                                                                                                                            | voltage                                      | -----                                                      |
|                                                                                                                                                                                                                                            | Frequency                                    | -----                                                      |
|                                                                                                                                                                                                                                            | Combined voltage & frequency                 | -----                                                      |
| <b>2.2</b>                                                                                                                                                                                                                                 | DC supply                                    | 198 to 240 V                                               |
| Note: During starting of largest 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. |                                              |                                                            |

**CHAPTER 18 : ACTUATORS****1.00.00 ELECTRICAL ACTUATORS WITH INTEGRAL STARTERS****1.01.00 SCOPE**

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

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

**1.02.00 CODES STANDARDS**

All the equipment specified herein shall comply with the requirements of the latest issue of the relevant National & International standards.

The design and materials used for the components shall also comply with the relevant National & International standards.

As a minimum requirement, the following standards shall be complied with :

Electric motor operated actuators: IS 9334

Degrees of protection provided by enclosures at low: IS 2147

voltage switch gear and control gear

Flame Proof enclosure at electrical apparatus: IS 2148

Specification for three phase induction motors: IS 325

AC contactor for voltages not exceeding 1000 V: IS 2959

Degree of protection provided by enclosures for : IS 4691

Rotating electrical machinery

Specification for rotating electrical machines: IS 4722

For other code refer Section D28.

**1.03.00 SERVICE CONDITIONS**

The actuator shall be integral type and suitable for operation in a hot, humid and tropical atmosphere, highly polluted at places with coal dust & fly ash and shall be suitable for an ambient temperature ranging from (-) 20 deg C to (+) 70 deg C.

Actuators for explosion-hazardous applications shall in addition be certified Flameproof for Zones 1 and 2 (Divisions 1 and 2 Group gases).

**2.00.00 RATING**

(a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%.

(b) Sizing:-

For Open/Close at rated speed against designed differential pressure at 90% of rated voltage.

For isolating service:- three successive open-close operations or 15 mins, whichever is higher. For regulating service 150 starts per hour or required cycles, whichever is higher.

**2.01.00 PERFORMANCES**

2.01.01 The actuator shall meet the following performance requirements:

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

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

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

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.

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

**2.02.00 SPECIFIC REQUIREMENT****2.02.01 CONSTRUCTION**

a) The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator and transmitter, . in built thermostat for overload protection, space heater and internal wiring. Actuator shall be integral type. Integral starters shall have facility to hook-up with plant DCS for positioning of limit and torque switches.

b) The actuator enclosure shall be totally enclosed, dust tight, weather proof (NEMA-6/IP-68) suitable for outdoor use without necessity of any canopy.

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

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

e) A lockable local/remote selector switch shall also be provided for selecting mode of operation.

## f) Gear Train :

Metal (Fibre gears are not acceptable) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energised.

## g) Manual Wheel:

Shall disengage automatically during motor operation.

2.02.02 **MOTOR**

The squirrel cage induction motor shall be designed for full voltage direct-on-line start, with starting current limited to 6 times full-load current. The motor shall be capable of starting at 85% of rated voltage and running at 80% of rated voltage at rated torque and also at 85% of rated voltage at 33% excess rated torque for a period of 5 minutes each. The motors shall otherwise generally conform with technical specification for motors mentioned elsewhere in this specification.

The actuators shall be sized so as to open or close valves/ dampers at rated speed enclosure shall not be more than 70 degree 'C' over ambient temp. of 70 deg.C as these are subjected to higher ambient conditions due to their vicinity to operate fluid on continuous load operation. The actuators shall be suitable for a relative humidity of 95%. Class of insulation shall be class-F and type of enclosure shall be IP-68.

The actuators shall be designed to be self locking upon loss of power. Motor shall be designed to close in 30 secs from full open position and shall have adequate capacity to open and close under full unbalanced design pressure.

The actuators shall be flange mounted to valve bonnets or with gearing and disengaging hand wheel for dampers.

2.02.03 **LIMIT SWITCHES**

Each motor actuator shall have Six (6) rotary drum position limit switches with two for open each with 2 NO + 2NC contacts and two for close each with 2 NO + 2 NC contacts positions, each with adjustable setting between fully open and fully closed positions. Each rotary drum limit switch shall have two (2) limit switches for intermediate open position each with 2 NO + 2 NC contacts. The limit switches shall have capacity of 5A at 240V AC or 0.5A at 220V DC.

Each motor actuator shall also have two (2) torque limit switches with four (4) normally opened and four (4) normally closed contacts each.

The torque switches shall have a minimum accuracy of 3% of set value. The torque switches shall be provided with calibrated knobs for setting desired torque and separate knobs shall be provided for open and close torque switches. The torque and position limit switches shall be housed in a separate enclosure with protection class as that of actuator.

The motor operators/actuators shall conform to AWWA specification and shall be capable of meeting 150 percent of unseating torque at specified voltage.

The motor actuators shall have 2 nos. potentiometric type transmitters of 100 ohm rating.

Torque switches shall function to stop the motor on closing. Upon actuation by the torque clutch it is restricted its attempt to open or close, thereby causing an overloading torque. Torque switches shall be non-self resetting type only (i.e.) once a particular direction torque switch operates, it will get resetted only when the equipment is operated in other direction.

All six (6) limit switches shall be changeover type and adjustable besides having the snap facility. All limit switches, contacts shall be wired up independently upto the terminal block.

#### 2.02.04. **POSITION INDICATOR/TRANSMITTER**

- a) Motor actuators shall be provided with clearly visible local position indicators mounted on the operator assembly itself. Suitable transducers shall be provided for remote indication of the position.
- b) To be provided for 0 to 100% travel.
- c) As required. Suitable for stabilized 4-20 mA signal, 2 wire inductive type, 24 volts DC operated.

#### 2.02.05. **HAND WHEEL**

Hand wheel shall enable manual operation in case of power failure but it shall get automatically disengaged when once the motor starts functioning. The effort required to operate manually shall not exceed 18 Kg.

#### 2.02.06 **SPACE HEATER**

Provision of space heater, if necessary, shall also be made with servomotor limit switch compartments. The space heaters shall be suitable for operation at 240V AC and its rating shall be indicated by the tenderer. Space heater circuit shall be complete with thermostat.

#### 2.02.07 **TERMINAL BOX**

- a) The terminals, terminal boards, terminal boxes, winding coils and associated equipments shall be suitable for connection to supply system having short circuit capacity specified in data sheet and clearance time determined by associated fuses. The terminal boxes shall be totally enclosed.
- b) 650V grade for power cables.

#### 2.02.08 **WIRING**

All wiring connections for various limit and torque switches, space heaters, position transmitters shall be brought out on separate terminal boards mounted on the valve, having liberal space for wiring and making connections to Purchaser's external circuits. Plug in type terminals shall be used suitable for analog/digital application. There shall be atleast 5 terminal spare to terminate spare cores of cable. Size of each control terminal shall be such that two (2) nos. lugged 2.5 sq.mm cable can be terminated on

each side. Power terminals shall be suitable for termination of 6 sq.mm lugged wire or as required depending on the motor capacity.

Motor terminal box and actuator terminal box shall be provided with cable glands to suit cable type and size.

Adequate earthing terminals preferably not less than 8 SWG GI wire shall be provided for suitable earthing system. Two earthing terminals shall be provided per motor, one No. on either side of the motor. The actuator shall include a diagnostic module, which will store and enable down load historical down load operation and torque data to permit analysis of actuator and valve in service performance. Data down load shall be carried out without removing any covers and all shall be available locally to the actuator or remotely via telecommunication data transfer. Diagnostic and configuration software shall be made for user PC system.

#### 2.02.09 INTERFACES:

Open/Close command termination logic with position & torque Limit Switches, positioner circuit shall be suitably built in the PCB inside the actuator.

- (a) For Binary Drive (both ON-OFF and INCHING type) :- Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided.

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

- (b) For Modulating Drive:- the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided
- (c) Open/close command termination logic shall be suitably built inside actuator.

#### 2.02.10 DRAWING AND DATA AND MANUALS

Data sheet for each of the actuator shall be furnished alongwith internal wiring diagram, suggested control schematic and limit switch contact development and manufacturer's catalogues.

#### 2.02.11 NAME PLATE

Name plate shall be provided on the actuators with at least following data  
(a) Tag no. (b) Torque Rating (c) Full travel time.

#### 2.02.12 PAINTING

The actuator shall be painted with epoxy based paint (the colour shall be indicated by the supplier). Paint shade shall be RAL 7032.

**2.02.13 PACKING**

The actuators shall be properly packed for transport by rail/ road/sea as applicable.

**2.02.14 OVERLOAD PROTECTION**

The actuator motor shall be provided with integral starter along with thermistor for overload protection.

**2.02.15 TESTS**

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

Following routine test shall be conducted as per IEC/IC standard. (a) Meggar Test, (b) Continuity test, (c) Operational test. Test certificates duly signed by inspecting agency shall be furnished.

The actuator shall be type tested as per IEC/National Standard, by international/national recognised test house. The test certificates issued by this house shall be furnished.

**2.02.16 TEST WITNESS**

Tests shall be performed in the presence of Owner/Purchaser's representative so desired by the Owner/ Purchaser. The contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

REV-0, DATE: 07.05.2019

**ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR( FOR EPC PROJECTS)****PACKAGES : DM PLANT****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT: 1X660MW PANKI TPS**

| S.NO | DETAILS                                                                                                                                                                                    | SCOPE<br>SUPPLY      | SCOPE E&C              | REMARKS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | 415V MCC                                                                                                                                                                                   | BHEL                 | BHEL                   | 240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.<br><b>OR (DE to select the choice applicable for their project))</b><br>415 V AC, 3 phase, 3 wire supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor. |
| 2    | Local Push Button Station (for motors)                                                                                                                                                     | BHEL                 | BHEL                   | Located near the motor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 3    | Power cables, control cables and screened control cables for<br>a) both end equipment in BHEL's scope<br>b) both end equipment in vendor's scope<br>c) one end equipment in vendor's scope | BHEL<br>BHEL<br>BHEL | BHEL<br>Vendor<br>BHEL | 1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly.<br>2. Termination at BHEL equipment terminals by BHEL.<br>3. Termination at Vendor equipment terminals by Vendor.                                                                                                                                                                                                                             |
| 4    | Junction box for control & instrumentation cable                                                                                                                                           | Vendor               | Vendor                 | Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling ( max 10-12 mtrs) and trunk cable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 5    | Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.                                                                                                    | Vendor               | Vendor                 | Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 6    | Cable trays, accessories & cable trays supporting system<br><br>100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling                                         | BHEL<br><br>Vendor   | BHEL<br><br>Vendor     | Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.                                                                                                                                                                                                                                                                                                                                                              |
| 7    | Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor                                                                                                                   | Vendor               | Vendor                 | 1. Double compression Ni-Cr plated brass cable glands<br>2. Solder less crimping type heavy duty tinned copper lugs for power and                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

REV-0, DATE: 07.05.2019

**ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR( FOR EPC PROJECTS)****PACKAGES : DM PLANT****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT: 1X660MW PANKI TPS**

| S.NO | DETAILS                                                                                                                                                                          | SCOPE<br>SUPPLY            | SCOPE E&C   | REMARKS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |                                                                                                                                                                                  |                            |             | control cables.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 8    | Conduit and conduit accessories for cabling between equipment supplied by vendor                                                                                                 | Vendor                     | Vendor      | Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 9    | Lighting                                                                                                                                                                         | BHEL                       | BHEL        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 10   | Equipment grounding (including electronic earthing) & lightning protection                                                                                                       | BHEL                       | BHEL        | Refer note no. 4 for electronic earthing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 11   | Below grade grounding                                                                                                                                                            | BHEL                       | BHEL        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 12   | LT Motors with base plate and foundation hardware                                                                                                                                | Vendor                     | Vendor      | Makes shall be subject to customer/ BHEL approval at contract stage.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 13   | Mandatory spares                                                                                                                                                                 | Vendor                     | -           | Vendor to quote as per specification.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 14   | Recommended O & M spares                                                                                                                                                         | Vendor                     | -           | As specified elsewhere in specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 15   | Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system). | Vendor                     | Vendor      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 16   | a) Input cable schedules (Control & Screened Control Cables)<br>b) Cable interconnection details for above<br>c) Cable block diagram                                             | Vendor<br>Vendor<br>Vendor | -<br>-<br>- | Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 17   | Electrical Equipment & cable tray layout drawings                                                                                                                                | Vendor                     | -           | For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL. |

REV-0, DATE: 07.05.2019

**ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR( FOR EPC PROJECTS)****PACKAGES : DM PLANT****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT: 1X660MW PANKI TPS**

| S.NO | DETAILS                         | SCOPE<br>SUPPLY | SCOPE E&C | REMARKS                         |
|------|---------------------------------|-----------------|-----------|---------------------------------|
| 18   | Electrical Equipment GA drawing | Vendor          | -         | For necessary interface review. |

**NOTES:**

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

REV: 00 DATE:

## STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: ELECTRIC HOIST

PROJECT 1X660 MW UPRVUNL PANKI TPS EXTN

SCOPE OF VENDOR: SUPPLY , ERECTION &amp; COMMISSIONING OF VENDOR'S EQUIPMENT

| <u>S. NO</u> | <u>DETAILS</u>                                                                                                                   | <u>SCOPE<br/>SUPPLY</u>    | <u>SCOPE E&amp;C</u> | <u>REMARKS</u>                                                                                                                                                                                                                  |
|--------------|----------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1            | Isolating Switch                                                                                                                 | Vendor                     | Vendor               | BHEL will provide one number 415 V(3ph, 3W) supply feeder only up to isolating switches for cranes. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel. |
| 2            | Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor. | Vendor                     | Vendor               | Cable from supply feeder to isolating switch shall be in BHEL scope.                                                                                                                                                            |
| 3            | Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).                                         | Vendor                     | Vendor               |                                                                                                                                                                                                                                 |
| 4            | Equipment Earthing                                                                                                               | Vendor                     | Vendor               | All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.                                                                |
| 5            | Motors                                                                                                                           | Vendor                     | Vendor               |                                                                                                                                                                                                                                 |
| 6            | Cable glands and lugs for equipment supplied by vendor                                                                           | Vendor                     | Vendor               | 1. Double compression Ni-Cr plated brass cable glands<br>2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.                                                                                 |
| 7            | a) Input cable schedules (C & I)<br>b) Cable interconnection details for above<br>c) Cable block diagram                         | Vendor<br>Vendor<br>Vendor | -<br>-<br>-          | Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.                                                                                    |
| 8            | Equipment layout drawings                                                                                                        | Vendor                     | -                    |                                                                                                                                                                                                                                 |
| 9            | Electrical Equipment GA drawing                                                                                                  | Vendor                     | -                    | For necessary interface review.                                                                                                                                                                                                 |

[illegible]

## CABLE SCHEDULE FORMAT

### ANNEXURE III

[illegible]



**TITLE:**  
**1 X 660 MW PANKI TPS EXTENSION  
 PROJECT**

SPECIFICATION NO. PE-TS-426-163-A001

SECTION I

**TECHNICAL SPECIFICATION FOR  
 DM PLANT**

**SUB-SECTION: IC**

REV. NO. 00

DATE :

### **SUB-SECTION IC**

#### **SPECIFIC TECHNICAL REQUIREMENTS (CONTROL & INSTRUMENTATION)**



Technical specification  
for  
1X660 MW TPS PANKI EXTN.

REV. NO. 00 DATE : 25.04.19

## SECTION -C

### SPECIFIC TECHNICAL REQUIREMENT

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                               |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|--|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>1X660MW PANKI TPS EXTN.</b>                                |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>DM PLANT</b> |  |
| <p><b>Specific Technical Requirements (C&amp;I):</b></p> <p>1.0 The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire DM Plant System. 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.</p> <p>2.0 All KKS tag nos. shall have prefix 10.</p> <p>3.0 The quantity of instruments for the system shall be as per tender P &amp; 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 &amp; ID. During detail engineering if any additional instruments &amp; items are required for safe &amp; reliable operation of plant, bidder shall supply the same without any price implication. Instrument installation and required accessories shall be in bidder's scope.</p> <p>4.0 <b>Redundancy of sensors shall be provided, irrespective of instrumentation shown in the PID, by bidder as per sheet attached in the specification. (ANNEXURE 1)</b></p> <p>5.0 Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness &amp; completeness of implementation of Control logic. Intimation to attained FAT shall be informed in 2 days' advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.</p> <p>6.0 Contractor's C&amp;I representative shall be present at BHEL-PEM for 3 man-days, for preparation of Control scheme of DM Plant. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.</p> <p>7.0 Bidder's presence is required for 15 Man days (in three visit) at site during commissioning of DDCMIS for assistance related to process correctness. Three visit with total 15 Man days (Excluding travel time) in</p> |                                                               |  |

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|      | <b>1X660MW PANKI TPS EXTN.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
|      | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>DM PLANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
|      | <p>which one visit shall be of 5 Man days each. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.</p>                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| 8.0  | <p>Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection (DCS end terminal details shall be provided to vendor during detail engineering to incorporate in cable interconnection), JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.</p> |  |
| 9.0  | <p>For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| 10.0 | <p>Bidder shall provide Cable Schedule in BHEL excel format which shall be provided during detailed engineering. Also, Cable Interconnections for Complete System shall be in Bidders' scope. DCS side details for hardwired signals shall be furnished by BHEL during detailed engineering.</p>                                                                                                                                                                                                                                                                     |  |
| 11.0 | <p>Interface of control panel, field instruments, actuators etc. with DCS based control system shall be as per Drive Control Philosophy enclosed in Section-D.</p>                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 12.0 | <p>Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook-up diagram of drives is included for reference.</p>                                                                                                                                                                                                                                                                                              |  |
| 13.0 | <p>MOVs (Motorized Valves) shall be integral type, if applicable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
| 14.0 | <p>Bidder to furnish electrical load/UPS load data during detailed engineering.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| 15.0 | <p>240 V AC (supply feeder)/415 V, 3 phase, 4 wire AC supply shall be provided by BHEL based on the load data provided by the bidder at contract stage for all equipment supplied by the bidder as part of contract. Any other voltage level (AC/DC) required will be derived by the bidder. Bidder to include necessary power distribution board in his scope and all necessary hardware/software for the same shall be in bidder's scope.</p>                                                                                                                      |  |

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|      | <b>1X660MW PANKI TPS EXTN.</b>                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|      | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>DM PLANT</b>                                                                                                                                                                                                                                                                                                                                                                                    |  |
| 16.0 | Power supply derived for Transmitters, contact interrogation, interposing relay and solenoid shall generally be ungrounded 24V D.C only.                                                                                                                                                                                                                                                                                                         |  |
| 17.0 | The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Solenoid Valve shall be rated for 24V DC only.                                                                                                                                                                                                                                                                                                      |  |
| 18.0 | Bidder shall provide starter panel for local start/ stop monitoring of auxiliaries and equipment along with status indications and alarms as per requirement. The requirement shall be decided during detailed engineering.                                                                                                                                                                                                                      |  |
| 19.0 | Local push buttons in the field shall be in Vendor's scope.                                                                                                                                                                                                                                                                                                                                                                                      |  |
| 20.0 | Local control panel if any required for operation shall be in bidder scope.                                                                                                                                                                                                                                                                                                                                                                      |  |
| 21.0 | Bidder to supply all the instruments (PT, LT, DPG, LG and DPS etc.) required for the package along with necessary fittings, accessories and valve manifold etc. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments. 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> . |  |
| 22.0 | All transmitters shall be smart type and shall have 4-20mA DC signal with superimposed digital communication (HART). Each Temperature element shall be complemented with temperature transmitters, compensating cable, JB/rack & other erection hardware. All transmitters shall be fitted with a local analog/digital indicator displaying appropriate physical units which may be read clearly from an easily accessible position.             |  |
| 23.0 | Use of process actuated switches shall be avoided unless Unavoidable.                                                                                                                                                                                                                                                                                                                                                                            |  |
| 24.0 | All instruments and control elements shall be terminated on JB/LCP in field and both instrument and JB/LCP are in bidder scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.                                                                                                                                                                             |  |
| 25.0 | Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However,                                                                                                                                                                                                                                                                                                |  |

|      |                                                                                                                                                                                                                                                                                                                                                       |  |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|      | <b>1X660MW PANKI TPS EXTN.</b>                                                                                                                                                                                                                                                                                                                        |  |
|      | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>DM PLANT</b>                                                                                                                                                                                                                                                                                         |  |
|      | <p>any instrument/ analyser installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.</p>                                                                                                                                                                                                      |  |
| 26.0 | DP instruments with minimum Capillary length of 15m is to be supplied.                                                                                                                                                                                                                                                                                |  |
| 27.0 | All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications.                                                                                                                                                                                                              |  |
| 28.0 | All field instruments enclosure shall be IP65 local panel/cabinet enclosure shall be IP 55, unless otherwise specified.                                                                                                                                                                                                                               |  |
| 29.0 | All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipments are protected against rain/ sunlight etc.                                                                                                                                     |  |
| 30.0 | The junction boxes/LIEs for termination of instruments are in bidder's scope.                                                                                                                                                                                                                                                                         |  |
| 31.0 | The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial/ time 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. |  |
| 32.0 | The make of all the items shall be from approved sub-vendor list.                                                                                                                                                                                                                                                                                     |  |
| 33.0 | Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.                                                                                                                                                                                                                                     |  |
| 34.0 | All Instruments must have separate tapping lines. Sharing of the same tapping pipe for redundant instruments or various different instruments is not acceptable.                                                                                                                                                                                      |  |
| 35.0 | 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.                                                                                                                                                             |  |
| 36.0 | 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.                                                                                                                    |  |

|      |                                                                                                                                                                                                                                                                                                                                                        |  |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|      | <b>1X660MW PANKI TPS EXTN.</b>                                                                                                                                                                                                                                                                                                                         |  |
|      | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>DM PLANT</b>                                                                                                                                                                                                                                                                                          |  |
| 37.0 | 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.                                                                                                                                            |  |
| 38.0 | 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/ analysers & JBs/Racks should be protruding on the walkway.                                                                                                                 |  |
| 39.0 | All field instruments shall be terminated on Junction box/Local control panel in field. All the instruments along with necessary fittings, accessories and valve manifold etc., erection hardware including racks, junction boxes, canopies, structural steel, LIE, LIR, actuator limit switches etc.as required shall be in vendor's scope of supply. |  |
| 40.0 | Bidder to provide erection hardware including canopies, structural steel as required.                                                                                                                                                                                                                                                                  |  |
| 41.0 | Bidder to perform tests of C&I items/instruments/systems as per quality plans/type test attached in the specification.                                                                                                                                                                                                                                 |  |
| 42.0 | 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.                                                                         |  |
| 43.0 | 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.                                                                                                                                               |  |
| 44.0 | Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.                                                                                                                                                                                                                                      |  |
| 45.0 | Mandatory spares have to be supplied by bidder as mentioned in the specification.                                                                                                                                                                                                                                                                      |  |
| 46.0 | 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.                 |  |

|                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                         |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|                                                                                                                                                                                                                                                                                                                              | <b>1X660MW PANKI TPS EXTN.</b>                                                                                                                                                                                                                                                                                          |  |
|                                                                                                                                                                                                                                                                                                                              | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>DM PLANT</b>                                                                                                                                                                                                                                                           |  |
| 47.0                                                                                                                                                                                                                                                                                                                         | The specifications for instruments mentioned in the specification are minimum requirements. Datasheets of instrument shall be subject to customer/owner approval.                                                                                                                                                       |  |
| 48.0                                                                                                                                                                                                                                                                                                                         | All approval/Inspection are to be carried out by Owner or owner appointed agency only.                                                                                                                                                                                                                                  |  |
| 49.0                                                                                                                                                                                                                                                                                                                         | Drawings/Documents and data to be furnished after award of the contract shall be in line with MDL furnished elsewhere in the specification.                                                                                                                                                                             |  |
| 50.0                                                                                                                                                                                                                                                                                                                         | Mandatory spare list as per 'List of mandatory spares' attached elsewhere in the specification is in vendor's scope.                                                                                                                                                                                                    |  |
| 51.0                                                                                                                                                                                                                                                                                                                         | Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract: <ul style="list-style-type: none"><li>• GA &amp; wiring diagram of local panel.</li><li>• Local control panel &amp; instruments data sheet.</li><li>• Any other document decided during detailed engineering.</li></ul> |  |
| <b>Note: -</b>                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                         |  |
| 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.                                                                                                       |                                                                                                                                                                                                                                                                                                                         |  |
| 5. In case of any discrepancy in Section-C and Section-D of the specification, Section-C shall prevail.                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                         |  |

**ANNEXURE - 1****(g) Redundancy requirements****i Triple Redundancy**

Triple Sensing device shall be provided for following applications:-

- a. **For** Binary and analog inputs required for protection of boiler, turbine and major auxiliaries of main plant whose non-availability may result in 50% loss of unit availability and loss of generation.
- b. Binary and analog inputs, which are, required for protection of more than one equipment as well as protection signals for important auxiliaries and HT Drives of main plant (fed by a supply feeder of ratings 3.3 kV onwards)/MDBP/TDBFP etc.,
- c. Separate triple sensors for Instruments required for auto starting of HT driven pumps or HT driven pump tripping due to very low level of water & discharge pressure very low.
- d. For binary and analog inputs which are also required for protection in addition to CLCS. The same shall include but not limited to the critical measurement used for following CLCS :-  
Furnace draft, main steam and reheat steam temperatures, feed-water flow, throttle pressure, turbine first stage pressure, separator level, LPH and HPH level, deaerator level, hotwell level, CEP minimum recirculation, BFP minimum recirculation etc.
- e. For lube oil protection of all the HT drives, 2 out of 3 logics and necessary pressure transmitters for lube oil pressure shall be provided by bidder accordingly. However for bearing / winding temperature of HT motor, refer Electrical subsections, Vol. IV.
- f. Left and right side shall be treated as individual path / individual parameter, and each side/path shall have own triple redundancy accordingly.

**ii Dual Redundancy**

Dual Sensing device shall be provided for following applications:

- a. For binary and analog inputs required for all other closed loop control system (CLCS), protection and interlock conditions purpose of other equipments.
- b. For Instruments required for auto starting of LT driven pumps or LT driven pump tripping due to very low level of water/discharge pressure very low.
- c. Dual redundant position transmitters shall be provided for Steam Admission Valves i.e. (Emergency Stop & Control Valves, Reheat Stop Valves & Control valves), Extraction steam QCNRV, CRH NRV.
- d. For instruments required for Heat rate measurements & PADO calculations.

- iii. For binary and analog inputs used for alarm and monitoring only, single sensor criteria shall be applicable.

| 1 X 660 MW PANKI EXTN.                  |                                                                                                                                                                                                                                                        |                                                                          |          |                               |                                           |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------|-------------------------------|-------------------------------------------|
| LIST OF DELIVERABLES (C&I) FOR DM Plant |                                                                                                                                                                                                                                                        |                                                                          |          |                               |                                           |
| S.No.                                   | DRAWING NO.                                                                                                                                                                                                                                            | DRAWING/DOCUMENT TITLE                                                   | CATEGORY | SCH. SUBMISSION WEEK FROM LOI | Resubmission after incorporating comments |
| 1                                       | PE-V0-426-163-I901                                                                                                                                                                                                                                     | CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM                            | A        | 5                             | 1 week                                    |
| 2                                       | PE-V0-426-163-I902                                                                                                                                                                                                                                     | INSTRUMENT & DRIVE LIST WITH SET POINTS                                  | A        | 8                             | 1 week                                    |
| 3                                       | PE-V0-426-163-I903                                                                                                                                                                                                                                     | FIELD JB/LIE/LIR,DRIVES TERMINATION DETAILS                              | A        | 9                             | 1 week                                    |
| 4                                       | PE-V0-426-163-I904                                                                                                                                                                                                                                     | DATASHEETS FOR INSTRUMENTS, ANALYSERS, JB's, etc. along with CATALOGUES* | A        | 8                             | 1 week                                    |
| 5                                       | PE-V0-426-163-I905                                                                                                                                                                                                                                     | INPUT / OUTPUT SIGNAL LIST (ANALOG & BINARY)                             | A        | 8                             | 1 week                                    |
| 6                                       | PE-V0-426-163-I906                                                                                                                                                                                                                                     | ANNUNCIATION & SOE LIST                                                  | A        | 8                             | 1 week                                    |
| 7                                       | PE-V0-426-163-I907                                                                                                                                                                                                                                     | QUALITY PLANS (INSTRUMENTS,LCP etc.)                                     | A        | 6                             | 1 week                                    |
| 8                                       | PE-V0-426-163-I908                                                                                                                                                                                                                                     | INSTRUMENT INSTALLATION/ HOOK-UP DRAWING                                 | A        | 6                             | 1 week                                    |
| 9                                       | PE-V0-426-163-I909                                                                                                                                                                                                                                     | CABLE SCHEDULE & CABLE INTERCONNECTION DETAILS IN BHEL FORMAT            | A        | 8                             | 1 week                                    |
| 10                                      | PE-V0-426-163-I910                                                                                                                                                                                                                                     | O & M MANUAL                                                             | A        | 10                            | 1 week                                    |
| 11                                      | PE-V0-426-163-I911                                                                                                                                                                                                                                     | GA & Wiring diagram of Local Control Panels                              | A        | 8                             | 1 week                                    |
|                                         | NOTES:                                                                                                                                                                                                                                                 |                                                                          |          |                               |                                           |
| 1                                       | Any other document for the package decided during detailed engineering shall be provided by Bidder without any commercial/ technical implication.                                                                                                      |                                                                          |          |                               |                                           |
| 2                                       | Reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats as applicable shall be provided to the successful bidder during detailed engineering. |                                                                          |          |                               |                                           |
|                                         |                                                                                                                                                                                                                                                        |                                                                          |          |                               |                                           |



|                                                                |                                      |        |
|----------------------------------------------------------------|--------------------------------------|--------|
| <b>TITLE:</b><br><b>1 X 660 MW PANKI TPS EXTENSION PROJECT</b> | SPECIFICATION NO. PE-TS-426-163-A001 |        |
|                                                                | SECTION: II                          |        |
|                                                                | SUB-SECTION:                         |        |
|                                                                | REV. NO. 00                          | DATE : |

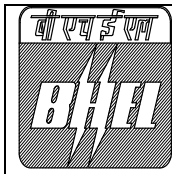
## SECTION – II

### GENERAL TECHNICAL REQUIREMENTS

SUB-SECTION IIA - GENERAL TECHNICAL REQUIREMENTS (MECHANICAL)

SUB-SECTION IIB - GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)

SUB-SECTION IIC - GENERAL TECHNICAL REQUIREMENTS (CONTROL & INSTRUMENTATION)



**TITLE:**  
**1 X 660 MW PANKI TPS EXTENSION  
PROJECT**

**TECHNICAL SPECIFICATION FOR  
DM PLANT**

SPECIFICATION NO. PE-TS-426-163-A001

SECTION: II

SUB-SECTION: IIA

REV. NO. 00

DATE :

**SUB-SECTION IIA**

**GENERAL TECHNICAL REQUIREMENTS (MECHANICAL)**

- Two(2)(1W+1S) Nos. of DM Plant Feed Pumps each of capacity 85 m<sup>3</sup>/hr complete with drive motor and all accessories and piping upto inlet of DM Plant building.



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



**CHAPTER 8: DEMINERALISING PLANT****8.0 DM PLANT**

- 8.1 The scope of supply for DM Plant shall include two (2) DM streams each of net capacity 65 cum/hr. Complete with regeneration facilities, chemical storage and handling equipments, two (2) nos. DM Water storage tanks of capacity 1000 cum each, waste neutralizing facilities with interconnecting pipings, valves and other accessories as detailed in data sheets and drawings.
- 8.2 The DM Plant shall be supplied complete and shall include, but not limited to the following. It shall also include the Interconnecting piping, valves & other accessories.
- a) Two (2) nos. Dual Media Filter along with 2 nos. blowers with all accessories.
  - b) Two (2) nos. Activated Carbon Filter with all accessories
  - c) Two (2) nos. Weak Acid Cation exchanger with all accessories.
  - d) Two (2) nos. Strong Acid Cation exchanger with all accessories.
  - e) One (1) no. Degasser system consisting of DG tower, Degassed Water Storage Tank, Degasser air blowers with drives and degassed water transfer pumps with drives.
  - f) Two (2) nos. Weak Base Anion exchanger with all accessories
  - g) Two (2) nos. Strong Base Anion exchanger with all accessories
  - h) Two (2) nos. Mixed Bed exchanger along with 2 nos. MB Air Blowers with all accessories.
  - i) Two (2) nos. Feed Tanks for Ultra Filtration Units, complete with integral pipe works, valves and all other accessories as required.
  - j) Three (3) nos. Feed Pumps for Ultra Filtration Units, each complete with electrical drive motor and all other accessories as required.
  - k) Two (2) nos. Pre Filters for Ultra Filtration Units, each complete with integral pipe works, valves and all other accessories as required.
  - l) Two (2) nos. Ultra Filtration Units (Bidder need to decide the number of modules for each Unit], each complete with integral pipe works, valves and all other accessories as required.
  - m) Complete acid / alkali handling, storage and regeneration system including Storage Tanks, Measuring Tanks, Unloading Pumps, Dosing Pumps with drive motors and interconnecting piping & valves.



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



- n) Two (2) nos. Back Flush Water Storage Tanks for Ultra Filtration Units, complete with integral pipe works, valves and all other accessories as required.
- o) Back Flush Pumps (no. has been indicated in P&ID ) for Ultra Filtration Units, each complete with electrical drive motor and all other accessories as required.
- p) One (1) no. Cleaning Solution Tank for Ultra Filtration Units, complete with integral pipe works, valves and all other accessories as required.
- q) Cleaning Solution Pumps (no. has been indicated in P&ID ) for Ultra Filtration Units, each complete with electrical drive motor and all other accessories as required.
- r) Three (3) nos. Cartridge Filter for cleaning of Ultra Filtration Units, complete with integral pipe works, valves and all other accessories as required.
- s) One (1) no. Backwash Waste Collection Sump, complete with integral pipe works, valves and all other accessories as required.
- t) Two (2) nos. Backwash Waste Transfer Pumps, each complete with electrical drive motor and all other accessories as required.
- ~~u) Two (2) nos. Demineralised water storage tanks complete with all accessories.~~
- v) Two (2) nos. safety shower with eye fountain & all accessories.
- w) One (1) no. centralized sampling rack for DM stream.
- x) All auto valves shall be pneumatic operated diaphragm valves.
- ~~y) One (1) no. Air reciver having capacity of minimum 5 Cum.~~
- z) One (1) no. neutralizing Pit in two compartments complete with integral pipe, valves & accessories common for DM & CPU regeneration waste.
- aa) Four (4) nos. of Effluent Disposal pumps. Two (2) nos in each compartment complete with electrical drive motors and other accessories as required.
- bb) One(1) no. of brine preparation tank with injection Pumps complete with all accessories.
- cc) One (1) no. of hot water tank complete with all accessories common for DM & CPU regeneration.
- dd) One (1) no. of alkali filter complete with all accessories.



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



- ee) Two (2) (1W+1S) nos. Back wash Water Pumps complete with drive motor and all accessories.
- ff) One (1) no. Overhead filtered water tank of capacity 100 m<sup>3</sup> complete with all accessories
- ~~gg) One (1) no. Condensate Storage Tank complete with all accessories.~~
- hh) Two (2) (1W+1S) nos. DM Regeneration Pumps complete with drive motor and all accessories.

### 8.3 Ion Exchange Resins for Cation, Anion & MB

RESINS shall be of reputed make and must have been in use in demineralising plants capable of producing water as specified or better for a period of not less than five (5) years.

- a. The weak acid cation resin shall be with carboxylic acid group suitable for cocurrent regeneration in thoroughfare and strong cation resins shall be high capacity premium grade sulphonated strong acidic cation resin in sodium form, microporous polystyrene bead type suitable for counter current regeneration. The attrition loss of the cation resins shall be guaranteed not to exceed three (3) percent per year for the five (5) years of operation. Resin quantity for cation exchanger shall be supplied to ensure minimum cation leak and regeneration level shall be selected so as keep sodium slip less than 0.5 ppm as Na in the treated water.
- b. The weak base anion resin shall be containing tertiary & quaternary ammonium group suitable for cocurrent regeneration in thoroughfare and strong anion resin shall be high capacity strong base, quaternary ammonium type-1 anion resin in chloride form, macroporous or isoporous, resistant to organic fouling suitable for counter – current regeneration. Anion resin should be able to with stand a temperature of 60<sup>0</sup> C. The attrition loss of the anion resins shall be guaranteed not to exceed five (5) percent per year for the first five (5) years of operation. Resin quantity for anion exchanger shall be supplied to ensure minimum anion leak and regeneration level shall be selected so as to keep silica slip less than 0.1 ppm as SiO<sub>2</sub> in the treated water.
- c. The mixed bed cation & anion resins shall be strong acid cation & strong base anion resin as described above suitable for co-current regeneration.
- d. Effective bed depth for each exchanger shall be 1.0m minimum.
- e. Quantity of 100 mm bed depth inert resin provided in cation & anion exchanger shall be indicated separately.



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



- f. Quantity of resins in each exchanger shall be adequate so as to require not more than one (1) regeneration per day at design capacity.
- g. At least 100% free-board shall be provided over resin bed for expansion during backwashing or addition of some extra resins if required.
- h. Regeneration effluent generated from cation and anion exchangers and also acidic and alkaline effluents from mixed bed shall be self neutralizing.
- i. Complete performance characteristics of the selected offered resins along with regenerant / neutralizing chemical consumption calculations shall be furnished.
- j. The resin shall be unaffected by acids, alkalis or common solvents. The resin shall be able to withstand a temperature of 60<sup>0</sup> C. (minimum) continuously.
- k. All Resins shall be supplied in manufacture's own sealed containers. No broken drum/containers or loose packing for resins will be accepted.
- l. The bidder should consider 10% (minimum) deration over the corrected exchange capacity, obtained from the manufacturer's published resin literature.
- m. The uniformity co-efficient of resins shall be less than 1.2.
- n. not used
- o. The regeneration level, resin quantity, treated water quality and chemical consumption for the Weakly Basic Anion and Strongly Basic Anion Exchangers shall be designed, selected and guaranteed based on regeneration of the same at 25 degree C. However, all other ion exchangers, degassifying tower and filters shall be designed for inlet water temperature of 10 degree C.
- p. For Ultra filtration Unit, after producing ultra filtered water for a period of time (typically half an hour to one hour), the productivity will be restored with a back flush cycle using permeate water (i.e. ultra filtered water). In the back flushing operation, accumulated particles will be removed from the surface of the hollow fibre and consequently pushed out of the lumen to the feed manifolds. Usually 30 – 60 seconds need to be considered for this back flushing operation.
- q. Duration of a chemical cleaning cycle is about 1.5 to 2.0 hours and the frequency ranges from weekly to yearly, depending on the fouling level of feed water. Field optimization may be required. Cleaning cycles involve flushing the membranes with water, recycling the chemicals through the cartridges and then again flushing the system with clean water.



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



- 8.3.1 Simultaneous semi-auto regeneration facility for one (1) No. stream shall be provided.
- (i) For the regeneration of cation exchanger units power water used shall be degassed water.
- (ii) For the regeneration of anion / mixed bed exchanger units power water used shall be demineralized water.
- 8.3.2 All header pipes shall be sized considering simultaneous operations of all streams at rated conditions. Regeneration system shall be sized for regeneration of one (1) stream at a time. All valves shall be located at an accessible height. All auto valves shall also be capable of operating manually.
- 8.3.3 All the storage/dosing tanks/pressure vessels etc. shall be fabricate considering minimum 2mm corrosion allowance (if unlined), milling allowance as per applicable code and 2mm thinning allowance.
- 8.3.4 Bidder shall supply first charge of filter media, resin, degasser tower packings, lubricating oil, inhibitor of oil & all the consumables including chemicals till the Trial Run Operation of the plant and additional chemicals of one (1) month requirement.
- 8.3.5 Pipe lines carrying water, chemicals, etc. should be sized on the following velocities :

|     |                                           | Velocity in m/sec. |             |                |
|-----|-------------------------------------------|--------------------|-------------|----------------|
|     |                                           | Pipe Size          |             |                |
|     |                                           | Below 50 mm        | 50 - 150 mm | 200 mm & above |
| a ) | Pump Suction for Water                    | -                  | 1.2 - 1.5   | 1.2 - 1.8      |
| b ) | Pump Discharge for Water                  | 1.2 - 1.8          | 1.8 - 2.4   | 2.1 - 2.5      |
| c ) | Header for Water                          | -                  | 1.5 - 2.4   | 2.1 - 2.4      |
| d ) | Pump suction for chemical solution        | 0.8 - 1.2          | 0.8 - 1.3   | -              |
| e ) | Pump discharge for chemical solution      | 1.2 - 1.4          | 1.3 - 1.5   | -              |
| f ) | Compressed air below 2 kg. /sq.cm (g)     | 15 - 20            | 20 - 30     | 25 - 35        |
| g ) | Compressed air [2 kg. /sq.cm (g) & above] | 20 - 30            | 25 - 40     | 35 - 45        |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001





DCPL

**Volume III :**  
Mechanical Works

**Ch 8 : DM Plant**  
Sheet | 7 of 23

**ANNEXURE-I: CLARIFIED WATER ANALYSIS**

| S. No. | Description                        | Unit                     | Parameter |
|--------|------------------------------------|--------------------------|-----------|
| 1      | Physical characteristics           |                          |           |
|        | pH at 25°C                         | -                        | 7.59      |
|        | Turbidity                          | NTU                      | <15       |
|        | Conductivity                       | µs /cm                   | 590       |
|        | Total Dissolved solids             | ppm                      | 285       |
|        | Total Suspended Solids             | ppm                      | <15       |
| 2      | Cations                            |                          |           |
|        | Calcium Hardness                   | ppm as CaCO <sub>3</sub> | 113.86    |
|        | Magnesium Hardness                 | ppm as CaCO <sub>3</sub> | 40        |
|        | Sodium + Potassium                 | ppm as CaCO <sub>3</sub> | 37.2      |
|        | Iron                               | ppm as CaCO <sub>3</sub> | 0.3       |
|        | Total Cations                      | ppm as CaCO <sub>3</sub> | 191.36    |
| 3      | Anions                             |                          |           |
|        | Bicarbonate                        | ppm as CaCO <sub>3</sub> | 97        |
|        | Carbonate                          | ppm as CaCO <sub>3</sub> | 0.34      |
|        | Hydroxyl                           | ppm as CaCO <sub>3</sub> | 0.02      |
|        | Chlorides                          | ppm as CaCO <sub>3</sub> | 27.1      |
|        | Sulphate                           | ppm as CaCO <sub>3</sub> | 66.4      |
|        | Nitrate                            | ppm as CaCO <sub>3</sub> | 0.5       |
|        | Total Anions                       | ppm as CaCO <sub>3</sub> | 191.36    |
| 4      | Carbon Di-oxide as CO <sub>2</sub> | ppm                      | 5.54      |
| 5      | Dissolved Silica                   | ppm as SiO <sub>2</sub>  | 10.0      |
| 6      | Colloidal Silica                   | ppm as SiO <sub>2</sub>  | 0.5       |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 5 : Water Treatment Plant**  
Sheet | 13 of 15

| S. No.      | Description                                                                  | Units       | Parameter                                                                                                                                           |
|-------------|------------------------------------------------------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| e.          | MOC                                                                          |             | RCC                                                                                                                                                 |
| <b>12.0</b> | <b>Thicked Sludge Sump</b>                                                   |             |                                                                                                                                                     |
| a.          | Number                                                                       |             | One                                                                                                                                                 |
| b.          | MOC & Type                                                                   |             | RCC under ground, outdoor local                                                                                                                     |
| c.          | Capacity                                                                     | cum         | 100                                                                                                                                                 |
| d.          | Instrumnet                                                                   |             | LS                                                                                                                                                  |
| e.          | Inside Protection                                                            |             | coal tar epoxy paint                                                                                                                                |
| <b>13.0</b> | <b>Thickened sludge transfer pumps</b>                                       |             |                                                                                                                                                     |
| a.          | Number                                                                       | Nos.        | 2 (1W+1S)                                                                                                                                           |
| b.          | Type                                                                         |             | Screw                                                                                                                                               |
| c.          | Capacity & head                                                              | M3/hr & mwc | 10(Min)<br>Bidder to indicate                                                                                                                       |
| d.          | Liquid to handled                                                            |             | Thickened sludge at 5% conc.                                                                                                                        |
| e.          | MOC<br>i. Pump Casing<br>ii. Stator<br>iii. Shaft<br>iv. Eccentric Rotor     |             | Cast Iron IS: 210 FG 260, 2% Ni<br>EPDM<br>SS: 316<br>SS: 316                                                                                       |
| <b>14.0</b> | <b>Centrifuge</b>                                                            |             |                                                                                                                                                     |
| a.          | Number                                                                       | Nos.        | Two (2) (1W+1S) 2x100%                                                                                                                              |
| b.          | Type                                                                         |             | Solid Bowl                                                                                                                                          |
| c.          | Capacity                                                                     | Cum/hr      | Not more than 10                                                                                                                                    |
| d.          | Inlet solid concentration                                                    |             | 5% from sludge thickner                                                                                                                             |
| e.          | Outlet Concentration                                                         |             | 20% Min.                                                                                                                                            |
|             | MOC<br>Bowl:<br>Conveyor:                                                    |             | SS-316<br>SS-316                                                                                                                                    |
| <b>15.0</b> | <b>Clarified Water Reservoir</b>                                             |             |                                                                                                                                                     |
| a.          | Number                                                                       | No.         | One (1)                                                                                                                                             |
| b.          | Effective capacity                                                           | m3          | 10000                                                                                                                                               |
| c.          | MOC                                                                          |             | RCC                                                                                                                                                 |
| d.          | Type of tank                                                                 |             | above ground                                                                                                                                        |
| e.          | Inside protection                                                            |             | Shall be coated with acrylic reinforced cementitious, flexible water proof coating conforming to BS 1881 Pts 1983/ DIN 1048- water penetration test |
| f.          | Free board                                                                   | mm          | 300 (min)                                                                                                                                           |
|             | Note: For Design Details please refer Volume III , Chapter 35 (V3B. Ch. 35). |             |                                                                                                                                                     |
| <b>16.0</b> | <b>Pumps</b>                                                                 |             | <b>DM Feed Pump</b>                                                                                                                                 |
| a.          | Numbers                                                                      | Nos.        | Two(2)<br>(1w+1s)                                                                                                                                   |
| b.          | Type                                                                         |             | -----Horizontal -----                                                                                                                               |
| c.          | Capacity                                                                     | CMH         | Not less than 85                                                                                                                                    |
| d.          | Head                                                                         | MWC         | As per process requirement                                                                                                                          |
| e.          | Type of lubrication                                                          |             | Self – lubrication                                                                                                                                  |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 5 : Water Treatment Plant**  
Sheet | 14 of 15

| S. No.      | Description                                                        | Units  | Parameter                                                                                                                                                                 |                           |
|-------------|--------------------------------------------------------------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| f.          | Speed of pump                                                      | RPM    | 1450                                                                                                                                                                      |                           |
| g.          | Material of Construction                                           |        |                                                                                                                                                                           |                           |
| i.          | Casing                                                             |        | 2.0% Ni-Cast iron IS 210 FG 260                                                                                                                                           |                           |
| ii.         | Impeller                                                           |        | AISI 316                                                                                                                                                                  |                           |
| iii.        | Shaft                                                              |        | SS 410                                                                                                                                                                    |                           |
| iv.         | Shaft sleeves                                                      |        | SS 316                                                                                                                                                                    |                           |
| v.          | Column pipe                                                        |        | CS IS 2062                                                                                                                                                                |                           |
| vi.         | Stuffing Box                                                       |        | 2.0% Ni-Cast iron IS 210 FG260                                                                                                                                            |                           |
| vii.        | Gland                                                              |        | 2.0% Ni-Cast iron IS 210 FG260                                                                                                                                            |                           |
| viii.       | Gland Packing                                                      |        | Branded / impregnate Teflon                                                                                                                                               |                           |
| ix.         | Gaskets                                                            |        | Neoprene Ruber                                                                                                                                                            |                           |
| x.          | Bolts & Nuts                                                       |        | SS for wetted Parts, CS-Non Wetted Parts                                                                                                                                  |                           |
| <b>17.0</b> | <b>Chlorination System</b>                                         |        | Raw Water                                                                                                                                                                 | Potable Water             |
| <b>17.1</b> | <b>Chlorination Ton Containers / Cylinders</b>                     | Nos.   | 10                                                                                                                                                                        | 2                         |
| i)          | Capacity                                                           | Kgs    | 900                                                                                                                                                                       | 100                       |
| ii)         | Material Of construction                                           |        | ASTM A 285 Grade C                                                                                                                                                        |                           |
| iii)        | Size                                                               |        | 760 dia X 2600L                                                                                                                                                           | As per std.               |
| <b>17.2</b> | <b>Chlorinator</b>                                                 | Nos.   | 2( 1w+1s)                                                                                                                                                                 |                           |
| i)          | Chlorination Capacity                                              | Kg/hr  | 12                                                                                                                                                                        | 0.2                       |
| ii)         | Type                                                               |        | Vaccum Feed floor mounted                                                                                                                                                 | Vaccum Feed floor mounted |
| iii)        | Accessories                                                        |        | Automatic Switch – over module<br>Vaccum Regulating valve, Flow rate indicator, Injectors, Chlorine leak detector, Diffuser. Emergency Leaked Chlorine Absorption System. |                           |
| <b>17.3</b> | <b>Handling System</b>                                             |        |                                                                                                                                                                           |                           |
| i)          | Capacity of Electrically operated Monorail Hoist ( Each)           | Tonnes | 1                                                                                                                                                                         | -----                     |
| ii)         | Lifting Bar with Loads indicator & clamping devices                |        | To be provided                                                                                                                                                            | -----                     |
| 18.0        | Safety & supervisory equipments                                    |        |                                                                                                                                                                           |                           |
| 18.1        | Gas Mask Oxygen Breathing Equipment along with Breathing Apparatus |        |                                                                                                                                                                           |                           |
| 18.1.1      | Quantity                                                           | Nos.   | 1                                                                                                                                                                         |                           |
| 18.1.2      | Capacity                                                           |        | One(1) hour minimum                                                                                                                                                       |                           |
| 18.1.3      | Accessories to be provided                                         |        | Full Mask , full vision face pieces, flow regulating valves and all other accessories                                                                                     |                           |
| 18.2.0      | Canister type breathing Apparatus                                  |        |                                                                                                                                                                           |                           |
| 18.2.1      | Number                                                             | Nos.   | One (1)                                                                                                                                                                   |                           |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
Mechanical Works

**Ch 8 : DM Plant**  
Sheet | 8 of 23

**TECHNICAL DATA SHEETS - DM PLANT**

|           |                                               |                                     |                                                                                                                                     |
|-----------|-----------------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <b>1.</b> | <b>Dual Media Filters</b>                     | Nos.                                | Two (2) (1W+1S) Vertical                                                                                                            |
| i)        | Design Flow per unit (net)                    | m <sup>3</sup> / hr                 | 85                                                                                                                                  |
| ii)       | Design Surface Flow Rate                      | m <sup>3</sup> /m <sup>2</sup> /hr  | 10                                                                                                                                  |
| iii)      | Free Board Space                              | %                                   | 75 min.                                                                                                                             |
| iv)       | Fill Material                                 |                                     | Quartz sand free from Carbonate & impurities & anthracite as per BSEN:12909.                                                        |
| v)        | Media Trap                                    | No.                                 | Two (2) per unit. At service & rinse outlet of filter.                                                                              |
| vi)       | Design code for Shell & Dish                  |                                     | IS:2825, IS:2062 for Shell and IS:2002, Gr I/SA515 Gr. 70 for Dish.                                                                 |
| vii)      | Material of Construction for Vessel Internals |                                     | Epoxy coated carbon steel                                                                                                           |
| viii)     | Internal painting<br>Primer:<br><br>Finish:   |                                     | Two (2) coats of high built epoxy zinc phosphate DFT 50 microns<br>Two (2) coats of high built epoxy zinc phosphate DFT 200 micron. |
| ix)       | External painting<br>Primer:<br><br>Finish:   |                                     | Two (2) coats of chlorinated rubber paint DFT 50 microns.<br>Two (2) coats of chlorinated rubber paint DFT 100 microns.             |
| x)        | Manhole /Handhole                             | No. mm                              | One (1) No. dia 500 mm/100 mm                                                                                                       |
| xi)       | Sight windows.                                | No.                                 | One (1)                                                                                                                             |
| xii)      | Guaranteed Effluent<br>a. Turbidity           |                                     | <1                                                                                                                                  |
| xiii)     | Back wash flow rate                           | m <sup>3</sup> / m <sup>2</sup> /hr | Bidder to decide                                                                                                                    |
| xiv)      | Filter Material depth                         | mm                                  | 1200                                                                                                                                |
| xv)       | Under Drain System                            |                                     | Strainers on plate                                                                                                                  |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
Mechanical Works

**Ch 8 : DM Plant**  
Sheet | 9 of 23

|           |                                               |                                     |                                                                     |
|-----------|-----------------------------------------------|-------------------------------------|---------------------------------------------------------------------|
| <b>2.</b> | <b>Activated Carbon Filters</b>               | Nos.                                | Two (2) (1W+1S) Vertical                                            |
| i)        | Design Flow per unit (net)                    | m <sup>3</sup> / hr                 | 65                                                                  |
| ii)       | Design Surface Flow Rate                      | m <sup>3</sup> /m <sup>2</sup> /hr  | 15                                                                  |
| iii)      | Free Board Space                              | %                                   | 75 min.                                                             |
| iv)       | Fill Material                                 |                                     | Activated Carbon.                                                   |
| v)        | Media Trap                                    | No.                                 | Two (2) per unit. At service & rinse outlet of filter.              |
| vi)       | Design code for Shell & Dish                  |                                     | IS:2825, IS:2062 for Shell and IS:2002, Gr I/SA515 Gr. 70 for Dish. |
| vii)      | Material of Construction for Vessel Internals |                                     | Epoxy coated carbon steel                                           |
| viii)     | Internal painting<br>Primer:                  |                                     | Two (2) coats of high built epoxy zinc phosphate DFT 50 microns     |
|           | Finish:                                       |                                     | Two (2) coats of high built epoxy zinc phosphate DFT 200 micron.    |
| ix)       | External painting<br>Primer:                  |                                     | Two (2) coats of chlorinated rubber paint DFT 50 microns.           |
|           | Finish:                                       |                                     | Two (2) coats of chlorinated rubber paint DFT 100 microns.          |
| x)        | Manhole /Handhole                             | No. mm                              | One (1) No. dia 500 mm/100 mm                                       |
| xi)       | Sight windows.                                | No.                                 | One (1)                                                             |
| xii)      | Guaranteed Effluent                           |                                     |                                                                     |
|           | a. Free Chlorine                              |                                     | Non-detectable                                                      |
|           | b. Organic Matte                              |                                     | Traces                                                              |
|           | c. Turbidity                                  |                                     | <1                                                                  |
| xiii)     | Back wash flow rate                           | m <sup>3</sup> / m <sup>2</sup> /hr | 15                                                                  |
| xiv)      | Filter Material depth                         | mm                                  | 1200                                                                |
| xv)       | Under Drain System                            |                                     | Strainers on plate                                                  |
| xvi)      | Characterstics of Activated Carbon            |                                     |                                                                     |
| a.        | Grade:                                        |                                     | Dechlorination Grade                                                |
| b.        | Bulk Density:                                 | Kg/m3                               | >400                                                                |
| c.        | Particle Density wetted in water:             | gm/cc                               | 1.3-1.4                                                             |
| d.        | Uniformity Coefficient                        |                                     | 1.5-1.6                                                             |
| e.        | Mean Particle Diameter                        | mm                                  | 1.2-1.4                                                             |
| f.        | Total Surface Area                            | m2/gm                               | >850                                                                |
| g.        | Iodine No.                                    | Min.                                | 850                                                                 |
| h.        | Moisture Content                              |                                     | 5%( Max.)                                                           |
| i.        | Ash Content                                   |                                     | 8%( Max.)                                                           |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



## DATA SHEETS – DM PLANT

| S. No. | Description                                             | Units                              | Parameter Cation                            |                                              | Anion                                                                                 |                                           | Mixed Bed |
|--------|---------------------------------------------------------|------------------------------------|---------------------------------------------|----------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------|-----------|
|        |                                                         |                                    | WAC                                         | SAC                                          | WBA                                                                                   | SBA                                       |           |
| 3.     | Exchanger Vessels                                       |                                    | Two (2) (1W+ 1S)                            | Two (2) (1W+ 1S)                             | Two (2) (1W+ 1S)                                                                      | Two (2) (1W+ 1S)                          |           |
| i)     | Number of streams                                       |                                    | Down flow                                   | Down flow                                    | Down flow                                                                             | Down flow                                 |           |
| ii)    | Service                                                 |                                    |                                             |                                              |                                                                                       |                                           |           |
| iii)   | Design flow per stream (net)                            | m <sup>3</sup> / hr                | 65                                          | 65                                           | 65                                                                                    | 65                                        |           |
| iv)    | Output per stream between two consecutive regenerations |                                    |                                             |                                              |                                                                                       |                                           |           |
|        | - Nett                                                  | m <sup>3</sup>                     | 1300                                        | 1300                                         | 1300                                                                                  | 9100                                      |           |
|        | - Gross                                                 | m <sup>3</sup>                     | 1300 + regeneration requirement down stream | 1300 + regeneration requirement down stream. | 1300 + regeneration requirement upstream.                                             | 9100 + regeneration requirement upstream. |           |
| v)     | Cycle time                                              | Hrs.                               | 20                                          | 20                                           | 20                                                                                    | 140                                       |           |
| vi)    | Regeneration time                                       | Hrs.                               | 4                                           | 4                                            | 4                                                                                     | 4                                         |           |
| vii)   | Design surface flow rate                                | m <sup>3</sup> /m <sup>2</sup> /hr | Not more than 40                            | Not more than 40                             | Not more than 40                                                                      | Not more than 60                          |           |
| viii)  | Free board                                              |                                    |                                             |                                              | At least 100% above resin bed                                                         |                                           |           |
| ix)    | Design code                                             |                                    |                                             |                                              | IS:2825,                                                                              |                                           |           |
|        | Material of Construction                                |                                    |                                             |                                              | Shell IS:2062 and Dish IS:2002, Gr I/SA 515 Gr. 70                                    |                                           |           |
| x)     | Shell lining (internal)                                 |                                    |                                             |                                              | Natural Rubber, 4.5 (minimum) in 3 layers, 65 ± 5 shore A to IS:4682 Part-I           |                                           |           |
| xi)    | External painting                                       |                                    |                                             |                                              | Three (3) coats of chlorinated rubber paint DFT 150 microns with two coats of primer. |                                           |           |
| xii)   | Manhole and hand Hole                                   | mm                                 |                                             |                                              | Two (2) each dia 500 and hand hole 100                                                |                                           |           |
| xiii)  | Sight windows.                                          | Nos.                               |                                             |                                              | Two (2) in each vessel                                                                |                                           |           |
| xiv)   | Resin                                                   |                                    |                                             |                                              |                                                                                       |                                           |           |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



| S. No. | Description                           | Units | Parameter                                                                                                            |                                                          | Anion                                                                                                                                            | Mixed Bed                                                                                                              |
|--------|---------------------------------------|-------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
|        |                                       |       | Cation                                                                                                               |                                                          |                                                                                                                                                  |                                                                                                                        |
| a.     | Type                                  |       | Cross linked polyacrylic matrix with carboxylic acid as functional group (gel type with particle size 0.3 to 1.2 mm) | Strongly Acidic Polystyrene Resin with DBV cross-linking | Macro-porous cross linked polystyrene matrix with tertiary amine (minimum 90%) as functional group. (gel type with particle size 0.3 to 1.2 mm). | High capacity strongly basic Type-I polystyrene resin with DBV cross-linking and quaternary ammonium functional group. |
| b.     | Minimum Resin Bed Depth               | mm    | 1000                                                                                                                 | 1000                                                     | 1000                                                                                                                                             | 500 for each type of resin                                                                                             |
| xv)    | Regeneration                          |       | Thoroughfare by Hydrochloric Acid                                                                                    | Thoroughfare by Sodium Hydroxide                         | By HCl and NaOH                                                                                                                                  |                                                                                                                        |
| xvi)   | Resin Trap                            |       | Two (2) per unit at service & rinse outlet                                                                           |                                                          |                                                                                                                                                  |                                                                                                                        |
| xvii)  | Material of Construction of Internals |       | As per manufacturer standard                                                                                         |                                                          |                                                                                                                                                  |                                                                                                                        |



1 x 660 MW - Panki Thermal Power Station  
Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 8 : DM Plant**  
Sheet | 13 of 23

| S. No.      | Description                                                                                                    | Units                    | Parameter                                                                                                        |
|-------------|----------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>4.</b>   | <b>Degasser System</b>                                                                                         |                          |                                                                                                                  |
| <b>i)</b>   | <b>Degasser Tower</b>                                                                                          | No.                      | One (1) Forced draft Vertical Cylindrical type                                                                   |
|             | a. Normal flow rate                                                                                            | m <sup>3</sup> /hr       | 130 (net). Bidder need to indicate the gross flow rate.                                                          |
|             | b. Packing Rings (Fill) Material.                                                                              |                          | Polypropylene or equivalent.                                                                                     |
|             | c. CO <sub>2</sub> content in treated water                                                                    | ppm as CaCO <sub>3</sub> | ≤ 5                                                                                                              |
|             | d. External painting                                                                                           |                          | Three (3) coats of chlorinated rubber paint DFT 300 microns with two coats of primer                             |
|             | e. Shell material                                                                                              |                          | FRP                                                                                                              |
|             | f. Internal Distributors                                                                                       |                          | Non-clogging, Non corrosive type.                                                                                |
|             | g. All internal fittings, water distribution tray and hand holes for loading and removal of packing rings etc. |                          | To be provided.                                                                                                  |
| <b>ii)</b>  | <b>Degassed Water Storage Tank</b>                                                                             |                          | One (1) no RCC tank having 3 mm thick jointless solvent free epoxy lining/PPG lining                             |
|             | a. Useful capacity of tank                                                                                     | M <sup>3</sup>           | Sufficient to store 60 min downstream requirement + water requirement for one DM chain regeneration +20 % margin |
| <b>iii)</b> | <b>Degasser Control Valve</b>                                                                                  | No.                      | One (1) Butterfly Valve                                                                                          |
|             | a. Location                                                                                                    |                          | Inlet to degasser                                                                                                |
|             | b. Material of construction                                                                                    |                          |                                                                                                                  |
|             | 1) Body                                                                                                        |                          | ASME SA 351 CF8M                                                                                                 |
|             | 2) Stem                                                                                                        |                          | ASME SA 479 Gr. 316                                                                                              |
|             | 3) Actuator                                                                                                    |                          | Pneumatic operated.                                                                                              |
| <b>iv)</b>  | <b>Degasser Air Blowers</b>                                                                                    | Nos.                     | Two (2) (1W + 1S) 100%                                                                                           |
|             | a. Type & Duty                                                                                                 |                          | Centrifugal; Continuous                                                                                          |
|             | b. Capacity                                                                                                    |                          | 100% requirement of one degasser tower.                                                                          |
|             | c. Location                                                                                                    |                          | Outdoor on degasser tank                                                                                         |
|             | d. Drive motor type                                                                                            |                          | Induction motor, 415V, 3Φ, 50 HZ.                                                                                |
| <b>v)</b>   | <b>Degassed Water Transfer Pumps</b>                                                                           | Nos.                     | Two (2) (1W+1S) 100%                                                                                             |
|             | a. Type & Operation                                                                                            |                          | Horizontal, Centrifugal, Continuous                                                                              |
|             | b. Suction condition                                                                                           |                          | Flooded.                                                                                                         |
|             | c. Capacity                                                                                                    |                          | Not less than 75 m <sup>3</sup> /hr                                                                              |
|             | d. Head                                                                                                        |                          | As per Process Requirement                                                                                       |
|             | e. Material of Construction                                                                                    |                          |                                                                                                                  |
|             | - Casing                                                                                                       |                          | Stainless steel CF 8M                                                                                            |
|             | - Impeller                                                                                                     |                          | Stainless steel CF 8M                                                                                            |
|             | - Shaft & Shaft sleeve material                                                                                |                          | Stainless steel SS Gr. 304 & SS316                                                                               |
|             | - Packing seal                                                                                                 |                          | Mechanical type                                                                                                  |
|             | - Drive motor                                                                                                  |                          | Induction motor, 415V, 3 Φ, 50 Hz, TEFC.                                                                         |
|             | - Common base plate                                                                                            |                          | Carbon steel IS:2062                                                                                             |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 8 : DM Plant**  
Sheet | 14 of 23

| S. No.     | Description                                 | Units          | Parameter                                                                                          |                                           |
|------------|---------------------------------------------|----------------|----------------------------------------------------------------------------------------------------|-------------------------------------------|
|            | f. Noise level                              |                | 85 DBA                                                                                             |                                           |
|            | g. Vibration                                |                | As per HIS                                                                                         |                                           |
|            | h. RPM                                      |                | 1480                                                                                               |                                           |
|            | i. Drive motor                              |                | Induction Motor 415V, 3 Phase, 50 Hz, TEFC                                                         |                                           |
|            | j. Interconnecting Piping Material          |                | Carbon Steel with Rubber lining.                                                                   |                                           |
| <b>5.</b>  | <b>Regeneration System</b>                  |                |                                                                                                    |                                           |
| <b>5.1</b> | <b>Acid / Alkali Unloading Pumps</b>        |                |                                                                                                    |                                           |
| i)         | Numbers required                            | Nos.           | Two (2) for acid / alkali each                                                                     |                                           |
| ii)        | Type & Location                             |                | Horizontal Centrifugal; Outdoor                                                                    |                                           |
| iii)       | Service                                     |                | Intermittent                                                                                       |                                           |
| iv)        | Capacity and head                           | M3/hr.,<br>MWC | 10 and head 15                                                                                     |                                           |
| v)         | Material of Construction                    |                | PP                                                                                                 |                                           |
| vi)        | Liquid to be handled                        |                | 30-35% HCl or 45-48% NaOH                                                                          |                                           |
| vii)       | Suction condition                           |                | Flooded                                                                                            |                                           |
| viii)      | Suction strainer                            |                | Required                                                                                           |                                           |
| ix)        | Material of Construction.                   |                |                                                                                                    |                                           |
|            | a. Casing                                   |                | Polypropylene                                                                                      |                                           |
|            | b. Impeller                                 |                | Polypropylene                                                                                      |                                           |
|            | c. Shaft                                    |                | BS 970, 080 M40 (EN-8)                                                                             |                                           |
|            | d. Shaft Sleeves                            |                | Ceramic / Alloy 20                                                                                 |                                           |
| x)         | Types of shaft sealing                      |                | Mechanical                                                                                         |                                           |
| xi)        | Pump speed                                  | RPM            | 1450                                                                                               |                                           |
| xii)       | Operating range                             | %              | 20-120 of design capacity                                                                          |                                           |
| xiii)      | Drive motor                                 |                | 415 V, 3Φ, 50 HZ TEFC.                                                                             |                                           |
| xiv)       | Accessories required between motor and pump |                | Coupling guard, drain plug, vent valve etc.                                                        |                                           |
| xv)        | Type of coupling between motor and pump     |                | Flexible coupling                                                                                  |                                           |
| <b>5.2</b> | <b>Bulk Storage Tank</b>                    |                | <b>Acid</b>                                                                                        | <b>Alkali</b>                             |
| i)         | Numbers required                            | Nos.           | Two (2)                                                                                            | Two (2)                                   |
| ii)        | Location                                    |                | Outdoor                                                                                            | Outdoor                                   |
| iii)       | Overall Capacity                            | M3             | Capacity required for 30 days operation of CPU & DM<br><b>OR</b><br>30 cum each which ever is more |                                           |
|            |                                             |                |                                                                                                    | 20 cum each which ever is more            |
| iv)        | Type                                        |                | Horizontal Cylindrical with Dished ends, Atmospheric.                                              |                                           |
| v)         | Material of Construction.                   |                | -----Carbon steel-----                                                                             |                                           |
|            | Protection                                  |                |                                                                                                    |                                           |
|            | a. Inside                                   |                | Rubber lining 4.5 mm thick in 3 layers                                                             |                                           |
|            | b. Outside                                  |                | Chlorinated rubber paint DFT 150 microns.                                                          | Chlorinated rubber paint DFT 150 microns. |
| vi)        | Concentration                               |                | 30-33%                                                                                             | 45-48%                                    |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 8 : DM Plant**  
Sheet | 15 of 23

| S. No. | Description                                                | Units | Parameter                                                                                                 |    |                                                                         |                                                                      |                                                                               |    |
|--------|------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------------------|----|-------------------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------|----|
| vii)   | Vent, overflow, Drain, fume absorber and sample connection |       | All pipe, flange & valves MOC CPVC. Piping upto inlet of each exchanger. Except Bulk Tank isolation valve |    |                                                                         |                                                                      |                                                                               |    |
| ix)    | Manhole, staircase, platform                               |       | -----Required-----                                                                                        |    |                                                                         |                                                                      |                                                                               |    |
| 5.3    | Fume Absorbers                                             |       |                                                                                                           |    |                                                                         |                                                                      |                                                                               |    |
| i)     | Numbers Required                                           |       | One per tank                                                                                              |    |                                                                         |                                                                      |                                                                               |    |
| ii)    | Material of construction                                   |       | CPVC                                                                                                      |    |                                                                         |                                                                      |                                                                               |    |
| 5.4    | Measuring Tanks                                            |       | Acid                                                                                                      |    |                                                                         | Alkali                                                               |                                                                               |    |
|        |                                                            |       | Cation Unit                                                                                               | MB | NP                                                                      | Anion Unit                                                           | MB                                                                            | NP |
| i)     | Numbers required                                           |       | 2                                                                                                         | 2  | 1                                                                       | 2                                                                    | 2                                                                             | 1  |
| ii)    | Type                                                       |       | -----Vertical-----                                                                                        |    |                                                                         |                                                                      |                                                                               |    |
| iii)   | Useful capacity of each tank                               |       | 125% of chemical requirement for one regeneration.                                                        |    |                                                                         |                                                                      |                                                                               |    |
| iv)    | Material of Construction.                                  |       | Carbon Steel with 4.5 mm thick rubber lining inside in 3 layers                                           |    |                                                                         |                                                                      |                                                                               |    |
| v)     | External protection                                        |       | Chlorinated rubber paint DFT 300 microns with two coats of primer.                                        |    |                                                                         |                                                                      |                                                                               |    |
| vi)    | Vent, overflow, Drain connection                           |       | Required, all pipe, flange & valves MOC-CPVC                                                              |    |                                                                         |                                                                      |                                                                               |    |
| vii)   | Agitator                                                   |       | ---                                                                                                       |    |                                                                         | One (1) per tank SS slow speed agitator with reduction gear & motor. |                                                                               |    |
| viii)  | MOC for Shaft & Impeller                                   |       |                                                                                                           |    |                                                                         | ASME SA 479 Gr. 316                                                  |                                                                               |    |
| ix)    | Dissolving baskets No. & MOC                               |       |                                                                                                           |    |                                                                         | One (1) per tank having MOC ASME SA 479 Gr. 316                      |                                                                               |    |
| 5.5    | Preparation Tanks/Vessels                                  |       | AC Filter                                                                                                 |    | Hot Water tank                                                          |                                                                      | Brine Preparation Tank                                                        |    |
| i)     | Type                                                       |       | Vertical Cylinder Pressure Vessels with Dished Ends                                                       |    |                                                                         |                                                                      |                                                                               |    |
| ii)    | Numbers Required                                           | Nos.  | One(1)                                                                                                    |    | One(1)                                                                  |                                                                      | One(1)                                                                        |    |
| iii)   | Liquid To be Handled                                       |       | NaOH                                                                                                      |    | Hot Water                                                               |                                                                      | Brine                                                                         |    |
| iv)    | Type Of Heater                                             |       | Not applicable                                                                                            |    | Electric (2x50%)                                                        |                                                                      | Not applicable                                                                |    |
| v)     | Location                                                   |       | Outdoor                                                                                                   |    |                                                                         |                                                                      |                                                                               |    |
| vi)    | Effective Capacity                                         |       | 10 m^3/hr                                                                                                 |    | Suitable Volume to meet the requirement for regeneration of one (1) bed |                                                                      | Suitable Volume to meet system requirements for one brine rejuvenation cycle. |    |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 8 : DM Plant**  
Sheet | 16 of 23

| S. No.     | Description                            | Units    | Parameter                                                                                                |                                                                                         |                                                       |
|------------|----------------------------------------|----------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------|
|            |                                        |          |                                                                                                          | volume of SBA at 40°C + regeneration of one (1) anion regeneration vessel + 20% margin. |                                                       |
| vii)       | Design Surface Flow Rate               | m3/m2/hr | 15                                                                                                       | Not Applicable                                                                          | Not Applicable                                        |
| viii)      |                                        |          |                                                                                                          |                                                                                         |                                                       |
| ix)        | Filter Media                           |          | Activated Carbon                                                                                         | Not Applicable                                                                          | Not Applicable                                        |
| x)         | Minimum Bed depth                      | mm       | 1000                                                                                                     | Not Applicable                                                                          | Not Applicable                                        |
| xi)        | Underdrain System                      |          | Strainer on plate                                                                                        | Not Applicable                                                                          | Not Applicable                                        |
| xii)       | Shell material                         |          | MS                                                                                                       | SS with Insulation                                                                      | MS                                                    |
| xiii)      | Shell Lining                           |          | Epoxy                                                                                                    | -----                                                                                   | Rubber lining                                         |
| xiv)       | External Painting                      |          | Chlorinated Rubber paint                                                                                 | -----                                                                                   | Chlorinated Rubber paint                              |
| xv)        | Accessories                            |          | Manhole, Handholes, vent & Drain Connection with required Valves                                         | Manhol, Handholes                                                                       | Vent Overflow & Drain connection with required Valves |
| <b>5.6</b> | <b>Concentration Meter</b>             |          | <b>Acid</b>                                                                                              | <b>Alkali</b>                                                                           |                                                       |
| i)         | Number                                 |          | -----One (1) per ejector-----                                                                            |                                                                                         |                                                       |
| ii)        | Type                                   |          | Density indicator (Hydrometer type)                                                                      |                                                                                         |                                                       |
| iii)       | Indication                             |          | -----Local-----                                                                                          |                                                                                         |                                                       |
| iv)        | Location                               |          | -----Diluted Acid/Alkali line-----                                                                       |                                                                                         |                                                       |
|            |                                        |          | -                                                                                                        |                                                                                         |                                                       |
| <b>6.0</b> | <b>Neutralising System</b>             |          |                                                                                                          |                                                                                         |                                                       |
| <b>6.1</b> | <b>Neutralisation Pit</b>              |          | One (1) (twin compartment)                                                                               |                                                                                         |                                                       |
| i)         | MOC & Protection                       |          | RCC & Acid / Alkali proof PPG lining                                                                     |                                                                                         |                                                       |
| ii)        | Effective capacity of each compartment | M3       | To hold waste generated from single regeneration of one stream of DM Plant + waste generated from single |                                                                                         |                                                       |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 8 : DM Plant**  
Sheet | 17 of 23

| S. No.                                                                       | Description                      | Units      | Parameter                                                                                                                                                             |                                    |                        |
|------------------------------------------------------------------------------|----------------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------|
|                                                                              |                                  |            | regeneration of one CP Service Vessel + 20% Margin.                                                                                                                   |                                    |                        |
| iii)                                                                         | Isolation gate valves            |            | To be provided                                                                                                                                                        |                                    |                        |
| 6.2                                                                          | Neutralised Waste Disposal Pumps |            | Two (2) (1w+1s) in each compartment.                                                                                                                                  |                                    |                        |
| i)                                                                           | Capacity and Head                | M3/hr, MWC | To empty pit in four (4) Hours Transfer water to CMB                                                                                                                  |                                    |                        |
| ii)                                                                          | Type                             |            | Vertical , Centrifugal                                                                                                                                                |                                    |                        |
| iii)                                                                         | Lubrication                      |            | Grease                                                                                                                                                                |                                    |                        |
| iv)                                                                          | Noise Level                      |            | 85 DBA                                                                                                                                                                |                                    |                        |
| v)                                                                           | Material of Construction         |            |                                                                                                                                                                       |                                    |                        |
|                                                                              | - Column Pipe                    |            | Stainless Steel CF 8M                                                                                                                                                 |                                    |                        |
|                                                                              | - Base Plate                     |            | Carbon Steel IS:2062                                                                                                                                                  |                                    |                        |
|                                                                              | - Impeller                       |            | Stainless Steel CF 8M                                                                                                                                                 |                                    |                        |
|                                                                              | - Shaft                          |            | Stainless Steel SS 304                                                                                                                                                |                                    |                        |
|                                                                              | - Shaft coupling                 |            | Stainless Steel SS 304                                                                                                                                                |                                    |                        |
|                                                                              | - Shaft sleeve                   |            | SS 316                                                                                                                                                                |                                    |                        |
| vii)                                                                         | Drive motor                      |            | Induction motor 415V, 3 phase 50Hz, TEFC                                                                                                                              |                                    |                        |
| 6.3                                                                          | Blowers                          |            | MB/N-PIT                                                                                                                                                              | DMF                                |                        |
| i)                                                                           | Quantity                         | Nos.       | Two (1W + 1S)                                                                                                                                                         | Two (1W + 1S)                      |                        |
| ii)                                                                          | Type                             |            | Twin lobe                                                                                                                                                             | Twin lobe                          |                        |
| iii)                                                                         | Location                         |            | Indoor inside DM Plant Building                                                                                                                                       | Indoor inside DM Plant Building    |                        |
| iv)                                                                          | Duty                             |            | Continuous                                                                                                                                                            | Continuous                         |                        |
| v)                                                                           | Capacity                         |            | As per process requirements                                                                                                                                           | As per process requirements        |                        |
| vi)                                                                          | Drive motor                      |            | Induction Motor 415 V; 3 Ph, 50 Hz                                                                                                                                    | Induction Motor 415 V; 3 Ph, 50 Hz |                        |
| 6.4                                                                          | D.M. Water Storage Tanks         |            |                                                                                                                                                                       |                                    |                        |
|                                                                              | i. Quantity                      | No.        | Two (2)                                                                                                                                                               |                                    |                        |
|                                                                              | ii. Capacity (effective)         | Cu.m       | 1000                                                                                                                                                                  |                                    |                        |
|                                                                              | iii. M.O.C.                      |            | M.S.E.P.                                                                                                                                                              |                                    |                        |
|                                                                              | iv. Accessories                  |            | The tanks shall be provided with 3 layers of floating polypropylene balls to avoid contact with CO <sub>2</sub> atmospheric oxygen along with breather and water seal |                                    |                        |
| Note: For Design Details please refer Volume III , Chapter 35 (V3B. Ch. 35). |                                  |            |                                                                                                                                                                       |                                    |                        |
| 7.0                                                                          | DM Water Pumps                   |            | DM Regeneration                                                                                                                                                       | DM Water Transfer                  | CPU Regeneration       |
| i)                                                                           | Number                           |            | Two (2) (1W+1S)                                                                                                                                                       | Two (2) (1W+1S)                    | Two (2) (1W+1S)        |
| ii)                                                                          | Type                             |            | Horizontal Centrifugal                                                                                                                                                | For Design Details please          | Horizontal Centrifugal |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 8 : DM Plant**  
Sheet | 18 of 23

| S. No.                                                                       | Description                            | Units | Parameter                                                                                                                                                             |
|------------------------------------------------------------------------------|----------------------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| iii)                                                                         | Operation                              |       | Intermittent                                                                                                                                                          |
| iv)                                                                          | Suction condition                      |       | Flooded                                                                                                                                                               |
| v)                                                                           | Capacity & head m <sup>3</sup> /hr MWC |       | As per process requirement                                                                                                                                            |
| vi)                                                                          | Material of Construction               |       |                                                                                                                                                                       |
|                                                                              | - Casing                               |       | Stainless Steel CF 8M -                                                                                                                                               |
|                                                                              | - Base plate                           |       | Carbon steel IS:2062                                                                                                                                                  |
|                                                                              | - Impeller                             |       | Stainless Steel CF 8M--                                                                                                                                               |
|                                                                              | - Shaft                                |       | Stainless steel SS 316-                                                                                                                                               |
|                                                                              | - Shaft coupling                       |       | Stainless Steel SS 304-                                                                                                                                               |
|                                                                              | - Shaft sleeve                         |       | -SS 316                                                                                                                                                               |
| vii)                                                                         | Vibration                              |       | As per HIS                                                                                                                                                            |
| viii)                                                                        | Lubrication                            |       | Grease-                                                                                                                                                               |
| ix)                                                                          | Noise Level                            |       | 85 DBA                                                                                                                                                                |
| x)                                                                           | RPM                                    |       | 15000 (asynchronous)                                                                                                                                                  |
| xi)                                                                          | Drive motor                            |       | Induction Motor 415 V, 3 Phase, 50 Hz, TEFC                                                                                                                           |
| 8.0 <b>Condensate Storage Tanks</b>                                          |                                        |       |                                                                                                                                                                       |
| i.                                                                           | Quantity                               | No.   | One (1)                                                                                                                                                               |
| ii.                                                                          | Capacity (effective)                   | Cu.m. | 500                                                                                                                                                                   |
| iii.                                                                         | M.O.C.                                 |       | M.S.E.P.                                                                                                                                                              |
| iv.                                                                          | Accessories                            |       | The tanks shall be provided with 3 layers of floating polypropylene balls to avoid contact with CO <sub>2</sub> atmospheric oxygen along with breather and water seal |
| Note: For Design Details please refer Volume III , Chapter 35 (V3B. Ch. 35). |                                        |       |                                                                                                                                                                       |
| 9.0 <b>Air Receiver Vessel</b>                                               |                                        |       |                                                                                                                                                                       |
| i)                                                                           | Quantity                               | No.   | One (1)                                                                                                                                                               |
| ii)                                                                          | Capacity                               | Cu.m. | 5                                                                                                                                                                     |
| iii)                                                                         | Design code                            |       | IS 2825                                                                                                                                                               |
| iv)                                                                          | MOC                                    |       | IS 2062                                                                                                                                                               |
| v)                                                                           | Design Pressure                        | Kg/hr | 10                                                                                                                                                                    |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 8 : DM Plant**  
Sheet | 19 of 23

| S. No. | Description               | Units                     | Parameter                                             |                                                      |
|--------|---------------------------|---------------------------|-------------------------------------------------------|------------------------------------------------------|
| vi)    | Manhole                   | No.                       | 2                                                     |                                                      |
| 10.0   | <b>Filter Water Tanks</b> |                           | <b>O/H</b>                                            |                                                      |
| i)     | Quantity                  | No.                       | One (1)                                               |                                                      |
| ii)    | Capacity                  | Cu.m.                     | 100                                                   |                                                      |
| iii)   | MOC                       |                           | -----MSEP-----                                        |                                                      |
| iv)    | Accessories               |                           | -----Level Switch & Control Valves etc-----           |                                                      |
| 11.0   | <b>Pumps</b>              |                           | Potable                                               | Filter Backwash                                      |
| i)     | Number                    |                           | Two (2)<br>(1W+1S)                                    | Two (2)<br>(1W+1S)                                   |
| ii)    | Type                      |                           | Design Details shall be as per Volume III, Chapter 07 | ---- Horizontal Centrifugal----                      |
| iii)   | Operation                 |                           |                                                       | ----- Intermittent ----<br>--                        |
| iv)    | Suction condition         |                           |                                                       | ----- Flooded -----<br>---                           |
| v)     | Capacity & head           | m <sup>3</sup> /hr<br>MWC |                                                       | As per process requirement                           |
| vi)    | Material of Construction  |                           |                                                       |                                                      |
|        | - Casing                  |                           |                                                       | -----Stainless Steel CF 8M -----                     |
|        | - Base plate              |                           | Design Details shall be as per Volume III, Chapter 07 | -----Carbon steel IS:2062----                        |
|        | - Impeller                |                           |                                                       | -----Stainless Steel CF 8M-----<br>-                 |
|        | - Shaft                   |                           |                                                       | -----Stainless steel SS 316-----<br>-                |
|        | - Shaft coupling          |                           |                                                       | -----Stainless Steel SS 304----<br>-                 |
|        | - Shaft sleeve            |                           |                                                       | -----SS 316-----<br>-----                            |
| vii)   | Vibration                 |                           |                                                       | -----As per HIS-----                                 |
| viii)  | Lubrication               |                           |                                                       | ----- Grease-----<br>--                              |
| ix)    | Noise Level               |                           | Design Details shall be as per Volume III, Chapter 07 | -----85 DBA-----                                     |
| x)     | RPM                       |                           |                                                       | -----15000 (asynchronous)-<br>-----                  |
| xi)    | Drive motor               |                           |                                                       | -- Induction Motor 415 V, 3 Phase, 50 Hz, TEFC ----- |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 8 : DM Plant**  
Sheet | 20 of 23

|      |                                                   |  |                                                                                                                                                                                                                                         |
|------|---------------------------------------------------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12.0 | <b>Feed Tanks For Ultrafiltration Units</b>       |  |                                                                                                                                                                                                                                         |
|      | Number                                            |  | Two (2)                                                                                                                                                                                                                                 |
|      | Type                                              |  | Vertical, Cylindrical, atmospheric shell type with flat bottom, roof with rafter                                                                                                                                                        |
|      | Type of fluid handled                             |  | Dematerialized water                                                                                                                                                                                                                    |
|      | Effective capacity of each Tank in m <sup>3</sup> |  | Not less than 100                                                                                                                                                                                                                       |
|      | Size                                              |  | To be indicated by the Tenderer                                                                                                                                                                                                         |
|      | Material of Construction                          |  |                                                                                                                                                                                                                                         |
|      | (a) Shell                                         |  | Carbon Steel as per IS-2062 or ASTM A 515 Gr. 70                                                                                                                                                                                        |
|      | (b) Roof and Bottom                               |  | Carbon Steel as per IS-2062 or ASTM A 515 Gr. 70                                                                                                                                                                                        |
|      | Protection                                        |  |                                                                                                                                                                                                                                         |
|      | (a) Internal                                      |  | Rubberlined                                                                                                                                                                                                                             |
|      | (b) External                                      |  | Three (3) coats of chlorinated rubber paint DFT 150 microns with two coats of primer.                                                                                                                                                   |
|      | Special accessories, if any                       |  | Conservation Vent Valve is required to be provided. Supports for the roof of the tank shall be so designed such that there shall be no members projected inside the tank in order to ease the rubber lining on inside of the tank roof. |
|      | Accessories                                       |  | Polypropylene Balls with Floating arrangements at the top of Feed Tanks for Ultra filtration Unit.                                                                                                                                      |
| 13.0 | <b>Feed Pumps For Ultrafiltration Units</b>       |  |                                                                                                                                                                                                                                         |
|      | Number                                            |  | Three (3) [Two (2) nos. will be connected to Two (2) nos. Feed Tank For UF Unit and one (1) no. will be as common standby]                                                                                                              |
|      | Fluid to be handled                               |  | DM Water                                                                                                                                                                                                                                |
|      | Duty                                              |  | Continuous and to be suitable for parallel operation.                                                                                                                                                                                   |
|      | Type of Pump                                      |  | Horizontal Centrifugal with closed impeller                                                                                                                                                                                             |
|      | Rated Capacity, in m <sup>3</sup> /hr             |  | Not less than 60                                                                                                                                                                                                                        |
|      | Head to be developed at rated capacity            |  | To be indicated by Tenderer to meet the requirements as per Tender Specification (C should be considered as 120 to calculate the frictional loss in pipe as per Hagen Williams Equation).                                               |
|      | Material of construction                          |  |                                                                                                                                                                                                                                         |
|      | Casing                                            |  | AISI-316.                                                                                                                                                                                                                               |
|      | Impeller                                          |  | AISI-316.                                                                                                                                                                                                                               |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 8 : DM Plant**  
Sheet | 21 of 23

|      |                                                                                  |  |                                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14.0 | <b>Ultra Filtration Unit</b>                                                     |  |                                                                                                                                                                                           |
|      | Number                                                                           |  | Two (2) nos. [One (1) no. is working and one (1) no. will be standby].                                                                                                                    |
|      | Description for each Unit                                                        |  |                                                                                                                                                                                           |
|      | Number Of Units                                                                  |  | One (1) No. Assembly Per Stream                                                                                                                                                           |
|      | No. of membranes / Unit                                                          |  | Suitable for the application                                                                                                                                                              |
|      | Capacity Net Of Each Unit, M <sup>3</sup> / Day                                  |  | Each Stream Should Deliver 1176 M <sup>3</sup> /Day of Treated Water                                                                                                                      |
|      | Membrane Type And Designation                                                    |  | Hollow Fibre Membranes                                                                                                                                                                    |
|      | Membrane Type                                                                    |  | Polysulfone                                                                                                                                                                               |
|      | Material Of Outer Shell                                                          |  | Polysulfone                                                                                                                                                                               |
|      | Colloidal Silica Rejection                                                       |  | 99.80%                                                                                                                                                                                    |
|      | Recovery                                                                         |  | 90%                                                                                                                                                                                       |
|      | Design Average Flux Rate                                                         |  | 70 Gfd (max.)                                                                                                                                                                             |
|      | Membrane Pore Size                                                               |  | 10,000 mwc (Molecular Weight Cut Off)                                                                                                                                                     |
|      | Total Pressure Drop Across The Unit Including Prefilter, Inlet & Outlet Pipework |  | 3 Kg / Cm <sup>2</sup> (G)                                                                                                                                                                |
| 15.0 | <b>Ultrafiltration Backflush Tank</b>                                            |  |                                                                                                                                                                                           |
|      | Numbers To be provided                                                           |  | Two (2)                                                                                                                                                                                   |
|      | Description for each Tank                                                        |  |                                                                                                                                                                                           |
|      | Effective capacity, in m <sup>3</sup>                                            |  | Not less than 100                                                                                                                                                                         |
|      | Material of Construction                                                         |  | Shall be same as that of DM Water Storage Tank.                                                                                                                                           |
| 16.0 | <b>Backflush Pump For Ultrafiltration</b>                                        |  |                                                                                                                                                                                           |
|      | Number                                                                           |  | Number as indicated in P&ID                                                                                                                                                               |
|      | Description for each Pump                                                        |  |                                                                                                                                                                                           |
|      | Fluid to be handled                                                              |  | DM water                                                                                                                                                                                  |
|      | Type of Pump                                                                     |  | Horizontal Centrifugal type                                                                                                                                                               |
|      | Rated Capacity, in m <sup>3</sup> /hr                                            |  | To be decided by the Tenderer                                                                                                                                                             |
|      | Head to be developed at rated capacity                                           |  | To be indicated by Tenderer to meet the requirements as per Tender Specification (C should be considered as 120 to calculate the frictional loss in pipe as per Hagen Williams Equation). |
|      | Material of construction                                                         |  |                                                                                                                                                                                           |
|      | Casing                                                                           |  | AISI-316.                                                                                                                                                                                 |
|      | Impeller                                                                         |  | AISI-316.                                                                                                                                                                                 |
| 17.0 | <b>Cleaning Solution Preparation Tank For Ultrafiltration</b>                    |  |                                                                                                                                                                                           |
|      | Numbers To be provided                                                           |  | Number as indicated in P&ID                                                                                                                                                               |
|      | Description for each Tank                                                        |  |                                                                                                                                                                                           |
|      | Type                                                                             |  | Vertical cylindrical with flat bottom.                                                                                                                                                    |
|      | Type of fluid to be handled                                                      |  | Cleaning Solution                                                                                                                                                                         |
|      | Effective capacity, in m <sup>3</sup>                                            |  | To be decided by the Tenderer considering 20% margin.                                                                                                                                     |
|      | Minimum Free Board, in mm                                                        |  | 300.                                                                                                                                                                                      |
|      | Material of Construction                                                         |  |                                                                                                                                                                                           |
|      | Shell                                                                            |  | Carbon steel as per IS 2062 or ASTM                                                                                                                                                       |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 8 : DM Plant**  
Sheet | 22 of 23

|      |                                                                |  |                                                                                                                                                                                                                                             |
|------|----------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |                                                                |  | A 515 Gr.70.                                                                                                                                                                                                                                |
|      | Dished Ends                                                    |  | Carbon steel as per IS 2062 or ASTM A 515 Gr.70.                                                                                                                                                                                            |
|      | External                                                       |  | Three (3) coats of chlorinated rubber paint DFT 150 microns with two coats of primer.                                                                                                                                                       |
| 18.0 | <b>Cleaning Solution Pump For Ultrafiltration Units</b>        |  |                                                                                                                                                                                                                                             |
|      | Number                                                         |  | Number as indicated in P&ID                                                                                                                                                                                                                 |
|      | Description for each Pump                                      |  |                                                                                                                                                                                                                                             |
|      | Fluid to be handled                                            |  | Cleaning Solution.                                                                                                                                                                                                                          |
|      | Type of Pump                                                   |  | Horizontal Centrifugal type                                                                                                                                                                                                                 |
|      | Rated Capacity, in m <sup>3</sup> /hr                          |  | Number to be decided by the Tenderer                                                                                                                                                                                                        |
|      | Head to be developed at rated capacity                         |  | 10 mlc minimum. If necessary, higher value needs to be considered by Tenderer to meet the requirements as per Tender Specification (C should be considered as 120 to calculate the frictional loss in pipe as per Hagen Williams Equation). |
|      | Material of construction                                       |  |                                                                                                                                                                                                                                             |
|      | Casing                                                         |  | AISI-304.                                                                                                                                                                                                                                   |
|      | Impeller                                                       |  | AISI-304.                                                                                                                                                                                                                                   |
| 19.0 | <b>Cartridge Filter for cleaning of Ultra Filtration Units</b> |  |                                                                                                                                                                                                                                             |
|      | Number                                                         |  | Three (3) nos.                                                                                                                                                                                                                              |
|      | Fluid o be Handled                                             |  | Cleaning Solution for UF Skid                                                                                                                                                                                                               |
|      | Capacity                                                       |  | Suitable & to be selected by the Bidder                                                                                                                                                                                                     |
|      | Material of construction                                       |  | FRP                                                                                                                                                                                                                                         |
|      | Cartridge                                                      |  |                                                                                                                                                                                                                                             |
|      | • Pore Size                                                    |  | 5 micron                                                                                                                                                                                                                                    |
|      | • Material of construction                                     |  | PP                                                                                                                                                                                                                                          |
| 20.0 | <b>BACKWASH WASTE COLLECTION SUMP</b>                          |  |                                                                                                                                                                                                                                             |
|      | Numbers To be provided                                         |  | One (1) no                                                                                                                                                                                                                                  |
|      | Description                                                    |  |                                                                                                                                                                                                                                             |
|      | Type                                                           |  | Rectangular and flat bottom.                                                                                                                                                                                                                |
|      | Type of fluid to be handled                                    |  | Backwash waste of DMF Unit and reject from UF Units                                                                                                                                                                                         |
|      | Effective capacity, m <sup>3</sup>                             |  | Suitable to hold backwash waste generated in single backwash of one (1) no. DMF for DM Plant + Reject from one(1) nos. of UF Unit in eight (8) hrs. However it shall not be less than 100 m <sup>3</sup> .                                  |
|      | Minimum Free Board, in mm.                                     |  | 500                                                                                                                                                                                                                                         |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



DCPL

**Volume III :**  
**Mechanical Works**

**Ch 8 : DM Plant**  
**Sheet | 23 of 23**

|      |                                                       |  |                                                                                                                                                                                                                                 |
|------|-------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | Material of Construction                              |  | RCC.                                                                                                                                                                                                                            |
|      | Type of Protection                                    |  | Epoxy Painted                                                                                                                                                                                                                   |
|      | Sludge Flushing Arrangement                           |  | Required through high pressure water and nozzles to ensure no deposition / settling of sludge.                                                                                                                                  |
| 21.0 | <b>BACKWASH WASTE TRANSFER PUMPS</b>                  |  |                                                                                                                                                                                                                                 |
|      | Number                                                |  | Two (2) [One (1) no. to be under operation and the other as standby].                                                                                                                                                           |
|      | Description for each Pump                             |  |                                                                                                                                                                                                                                 |
|      | Type                                                  |  | Vertical, Centrifugal Non Clog type                                                                                                                                                                                             |
|      | Rated Capacity m <sup>3</sup> /hr                     |  | Not be less than 75 (To be suitable to meet the system requirements).                                                                                                                                                           |
|      | Tentative Head to be developed at rated capacity, MLC |  | To be specified by the Tenderer considering 10% margin to meet the requirements of the system as per Tender Specification. (C should be considered as 120 to calculate frictional loss in pipe as per Hagen Williams Equation). |
|      | Material of construction                              |  |                                                                                                                                                                                                                                 |
|      | Casing                                                |  | Ni hard C.I. as per ASTM 532.                                                                                                                                                                                                   |
|      | Shaft                                                 |  | EN-8 as per BS-970.                                                                                                                                                                                                             |
|      | Impeller                                              |  | Ni hard C.I. as per ASTM 532.                                                                                                                                                                                                   |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



## DATA SHEET FOR POTABLE WATER PUMPS

| Sl. No. | Item                                         | Units               | Description                                                                     |
|---------|----------------------------------------------|---------------------|---------------------------------------------------------------------------------|
| 1.      | Quantity                                     | Nos.                | 2 (1W + 1S)                                                                     |
| 2.      | Pump capacity (approx.)                      | M <sup>3</sup> / hr | By bidder after taking 10% margin on required flow.                             |
| 3.      | Pump total head excluding losses in the pump | MWC                 | By bidder (pump shall have 10% margin on friction head over actual requirement) |
| 4.      | Pump speed (max.)                            | RPM                 | 1500                                                                            |
| 5.      | Type of pump                                 |                     | Horizontal split casing                                                         |
| 6.      | Location                                     |                     | Outdoor                                                                         |
| 7.      | Liquid handled                               |                     | Filtered Water                                                                  |
| 9.      | Type bearing lubrication                     |                     | Self                                                                            |
| 10.     | Liquid for lubrication                       |                     | Pumped liquid                                                                   |
| 11.     | Type of pump motor coupling                  |                     | Flexible                                                                        |
| 12.     | Thrust bearing location                      |                     | In pump and motor                                                               |
| 13.     | Pump operating range                         |                     | 70% to 130% of rated capacity                                                   |
| 14.     | Materials of construction                    |                     |                                                                                 |
|         | a. Casing                                    |                     | 2% NiCr IS 210 Gr FG 260                                                        |
|         | b. Impeller                                  |                     | CF 8M                                                                           |
|         | c. Shaft                                     |                     | SS 410                                                                          |
|         | d. Shaft Sleeve                              |                     | SS 410 (Hardened)                                                               |
|         | e. All hardware under water                  |                     | SS 304                                                                          |
|         | f. Stuffing Box Packing                      |                     | Asbestos Free                                                                   |
|         | h. Base Plate                                |                     | MS IS 2062 epoxy painted                                                        |

## TECHNICAL SPECIFICATION FOR PRESSURE AND STORAGE VESSELS

### 1.00.00 INTENT OF SPECIFICATION

This specification covers the design, manufacture, shop testing, shop testing, construction, fabrication, erection, testing, inspection & commissioning of pressure and storage vessels at works & site.

### 2.00.00 CODES AND STANDARDS

The design, manufacture, shop testing, site fabrication and erection, testing and commissioning of the pressure vessels and atmospheric storage tanks vessels shall conform to the latest revisions of the following standards, in addition to other standards addressed elsewhere in the Bid Specification subject to any modification and requirement, as specified elsewhere:

|    |                              |                                                                                                                                                                              |
|----|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a) | ASME Section VIII            | Rules for Construction of Pressure Vessels                                                                                                                                   |
| b) | ASTM Standards               | Standards published by American Society for Testing and Materials                                                                                                            |
| c) | BS EN 12285-2                | Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non-flammable water polluting liquids |
| d) | IS-803                       | Code of Practice for Design Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks                                                             |
| e) | IS-816                       | Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel                                                                                         |
| f) | IS-817                       | Code of Practice for Training and Testing of Metal Arc Welders                                                                                                               |
| g) | IS-822                       | Code of Procedure for Inspection of Welds                                                                                                                                    |
| h) | IS-1363<br>Part 1 to Part 3  | Hexagon Head Bolts, Screws and Nuts of Product Grade C                                                                                                                       |
| i) | IS-1367<br>Part 1 to Part 16 | Technical Supply Conditions for Threaded Steel Fasteners                                                                                                                     |
| j) | IS-2002                      | Steel Plates for Pressure Vessels for Intermediate                                                                                                                           |

|    |                              |                                                                               |
|----|------------------------------|-------------------------------------------------------------------------------|
|    |                              | and High Temperature Service including Boilers                                |
| k) | IS-2062                      | Hot Rolled Medium and High Tensile Structural Steel                           |
| l) | IS-2825                      | Code for Unfired Pressure Vessels                                             |
| m) | IS-3133                      | Manhole and Inspection Openings for Chemical Equipment - General Requirements |
| n) | IS-4049<br>Part 1 & Part 2   | Formed Ends for Tanks and Pressure Vessels                                    |
| o) | IS-4682<br>Part 1 to Part 10 | Code of Practice for Lining of Vessels and Equipment for Chemical Processes   |
| p) | IS-4864 to IS-4870           | Shell Flanges for Vessels and Equipment                                       |

### 3. 00.00 **GENERAL DESIGN FEATURES**

3. 01.00 Design of all pressure vessels shall conform to IS 2825 or ASME Section VIII Division-I or equivalent code / standard (subject to approval by Purchaser).

3. 02.00 Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS-803.

Supporting frame where required for design of Demineralized Water Storage Tanks shall be in accordance with IS-800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents.

3. 03.00 Design of all horizontal cylindrical atmospheric storage tank containing decationized water, acid, alkali and other chemicals shall conform to BS EN 12285-2.

3. 04.00 Design temperature of all pressure vessels and atmospheric storage tanks shall be 10 deg. C higher than the maximum temperature that any part of the vessel / tank is likely to attain during operation.

3. 05.00 Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 5% additional margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pumps suction, if any.

3. 06.00 In case, tank is subjected to vacuum under any situation, the same shall be duly considered as one of the criteria for design of the tank.

3. 07.00 Each pressure vessel / atmospheric storage tank without inside rubber lining shall have a corrosion allowance of minimum 2.0 mm.

3. 08.00 Mill tolerance as per applicable code (minimum 0.3 mm) shall be duly considered for each shell as well as dished end.

3. 09.00 Thinning allowance of 2.0 mm (minimum) shall be considered for each dished end.

3. 10.00 Effective liquid volume for an atmospheric storage tanks tank shall be considered as the liquid volume in between the design highest operating level / design highest level switch set point and design lowest operating level / design lowest level switch set point.
3. 11.00 A liquid volume (corresponding to a minimum of 100 mm shell / liquid height in between design lowest operating level / design lowest level switch set point and top of side mounted outlet nozzle / bottom of tank) below the required effective liquid volume shall be considered & provided for satisfactory functioning of concerned level switch.
3. 12.00 Each atmospheric tank shall have sufficient free board (minimum 300 mm unless specified otherwise) above the design highest level / design highest level switch set point.
3. 13.00 The invert of overflow nozzle shall be kept at least 50 mm or 5 % of total height whichever is higher above the design highest level / design highest level switch set point for each of the atmospheric tanks, except for the Demineralized Water Storage Tanks.
3. 14.00 For Demineralized Water Storage Tanks, the invert of overflow nozzle shall be kept at least 500 mm or 5 % of total shell height whichever is higher above the design highest level / design highest level switch set point.
3. 15.00 A minimum 100 mm shell height shall be provided above the top of overflow nozzle of each atmospheric storage tank.
3. 16.00 Wall thickness of each of atmospheric tanks shall not be less than 6 mm. If higher thickness for any atmospheric storage tank is specified elsewhere in this Specification, the same shall be provided.
3. 17.00 Vessels coming under preview of IBR shall be designed accordingly.
4. 00.00 **MATERIAL OF CONSTRUCTION**
4. 01.00 The pressure vessels shall be designed as Class 3 vessels (as per IS-2825) and fabricated of steel as per IS-2062 / IS-2002 Grade 3 or SA-515 / 516 Grade 60 / 70 In case, the vessels are designed as Class 1 or Class 2 vessels (as per IS-2825), the material of construction shall conform to IS-2002 Grade 3.
4. 02.00 Atmospheric storage tanks shall be fabricated of mild steel as per IS-2062.
4. 03.00 The material of construction for various connections, for all the lined or unlined vessels/tanks shall be same as that of interconnecting piping material suitably lined wherever required. The pipe flanges, manhole/manhole covers, reinforcement pads etc. shall be fabricated out of the same material as that one used for the vessel / tank. However, screwed fittings for instrumentation, sample connection, drain connection of size 25 mm NB and less shall be of stainless steel construction (SS-316).
-

---

**5. 00.00 FABRICATION**

5. 01.00 All pressure vessels and storage tanks except the large tanks like Demineralised Water Storage Tanks should preferably be fabricated and tested completely at manufacturer's works to ensure better workmanship.
5. 02.00 The plates to be used for fabrication shall preferably have a minimum width of 1500 mm.
5. 03.00 Ends of pressure vessels shall be of dished design and constructed of forging, pressing or spinning as per IS-4049.
5. 04.00 Interior surfaces of all atmospheric storage tanks shall be clear of stiffeners and other structural supports. Tanks shall be reinforced and stiffened externally as required.
5. 05.00 Plates to be used for fabrication of atmospheric vertical storage tanks shall be accurately formed in bending rolls to the diameters called for and cold rolled through plate bending machine by several number of passes to true curvature and joined by welding.
5. 06.00 The atmospheric vertical storage tanks shall have flat bottom.
5. 07.00 Ends of atmospheric horizontal storage tanks shall be of dished design and constructed of forging, pressing or spinning as per IS-4049. Conical or Flat Ends shall not be accepted.
5. 08.00 All welding shall be as per IS-816 or equivalent code (subject to approval by Purchaser). The qualification of the welders should be as specified in IS-817 and welding electrodes shall be as per relevant Codes / Standards.
5. 09.00 Bidder shall state clearly in his proposal the make and type of welding rods necessary for fabrication / construction work.
5. 10.00 Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. The Bidder shall indicate in drawing, the sequence of welding proposed which should meet prior approval of the Purchaser. Welding shall not be carried out when the surface of the parts to be welded are wet from any cause and during periods of rain and high winds unless the welder and work are properly shielded.
5. 11.00 All seams shall be so positioned that they do not pass through connections of vessel / tank. The connections shall be flushed with inner surface of vessel / tank and welded continuous on both sides of the vessel / tank. Sharp inside edges shall be rounded to a minimum 3 mm radius. Inside seam weld shall be ground smooth, suitable for application of corrosion resistant coating / lining.
5. 12.00 All the joints (circumferential / longitudinal) shall be double butt welded with full penetration or single butt welded without backing strip. For joints involving small thickness 6 mm or less, back chipping to metal followed by DP test and re-welding shall be done to have full penetration.
5. 13.00 All internal baffles, wear plates, pipes etc. shall be continuously welded on both sides at all contact points with full fillet welds which shall be free of voids, gaps,
-

---

|          |                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | craters, high spots, sharp edges, and undercutting. Sharp edges shall be ground to a 3 mm minimum radius.                                                                                                                                                                                                                                                                                                              |
| 5. 14.00 | All welds on inner surface of vessel / tank shall be free of voids, gaps, craters, pits, high spots, sharp edges, abrupt ridges and valleys or undercut edges. High spots, irregularities and sharp edges shall be removed by grinding.                                                                                                                                                                                |
| 5. 15.00 | Weld splatter shall be removed.                                                                                                                                                                                                                                                                                                                                                                                        |
| 5. 16.00 | Inspection of all welds shall be carried out in accordance with IS-822 'Code of Practice for Inspection of Welds.'                                                                                                                                                                                                                                                                                                     |
| 6. 00.00 | <b>APPURTENANCES</b>                                                                                                                                                                                                                                                                                                                                                                                                   |
| 6. 01.00 | Internals for pressure vessels and atmospheric storage tanks shall be provided as detailed out elsewhere in the specification and as further required.                                                                                                                                                                                                                                                                 |
| 6. 02.00 | All the pressure vessels and atmospheric storage tanks shall be provided with drain connections along with drain valves of suitable size.                                                                                                                                                                                                                                                                              |
| 6. 03.00 | All the pressure vessels and atmospheric storage tanks shall be provided with the vent connections. The design shall be as to offer adequate area for venting. Venting area shall be such that over pressure/vacuum is not created during maximum filling / withdrawal rate. The maximum withdrawal rate for the Demineralized Water Storage Tanks shall be intimated later at detail engineering stage to the Bidder. |
| 6. 04.00 | Various instrumentation and the fittings required for the pressure vessels and atmospheric storage tanks shall be provided as elaborated elsewhere in the specification.                                                                                                                                                                                                                                               |
| 6. 05.00 | <b>Manholes / Hand Holes</b>                                                                                                                                                                                                                                                                                                                                                                                           |
| 6.05.01  | Manholes shall be provided for all pressure vessels and atmospheric storage tanks to provide easy access into the same. The diameter shall be minimum 500 mm and each manhole will be provided with cover plate, nuts, bolts and gaskets to ensure leak tightness at the test pressure. Manholes shall be davit type for rubber lined vessels.                                                                         |
| 6.05.02  | Each of the pressure vessels and horizontal type storage tanks shall be provided with at least one manhole at the top.                                                                                                                                                                                                                                                                                                 |
| 6.05.03  | Each of the vertical type atmospheric storage tanks with diameter 1200 mm or more shall be provided with a manhole on the top. For the Demineralized Water Storage Tanks, manholes shall be provided as per IS-803.                                                                                                                                                                                                    |
| 6.05.04  | Each of the pressure vessels filled with ion exchange resins shall be provided with a handhold of diameter at least 150 mm at a level in the vicinity of bottom of resin bed.                                                                                                                                                                                                                                          |
| 6.05.05  | The required lining / coating for the inside surface of the manhole / handhold, nozzle and cover plate of the manhole/ handhold shall be same as that of the respective vessel/tank.                                                                                                                                                                                                                                   |
| 6. 06.00 | <b>Nozzle Connections</b>                                                                                                                                                                                                                                                                                                                                                                                              |

---

- 
- 6.06.01 Bidder shall furnish all materials required for nozzle connections with reference to system requirements. In addition to these, additional nozzle connections, if required by the Purchaser for the inter-connection with other systems / piping / instruments etc. shall also be provided. Such additional requirements may be intimated to the Bidder later at detail engineering stage and Bidder shall provide the same complete with necessary supports and other accessories without any sort of price implication whatsoever.
- 6.06.02 Nozzle wall thickness shall be as per relevant code for design to be followed for the vessel/tank in questions.
- 6.06.03 All flanged connections should be supplied complete with matching counter flanges, bolts, nuts and gasket materials. The flange design (thickness and drilling etc.) shall match with the interconnected piping flanges.
- 6.06.04 Bolts and nuts to be used externally to the vessels shall be of hexagonal head conforming to IS-1367. However fasteners if any within tanks shall be of SS-316 / SS-304 or Hastalloy-B as per the duty conditions / requirements.
- 6.06.05 Gaskets shall be of full face type.
6. 07.00 Sight glasses shall be provided for the tanks/vessels as specified elsewhere in the specification. The material for sight glass shall be high quality transparent PLEXIGLASS of sufficient thickness to withstand the test pressure. The sight glass shall be provided with suitable gaskets and bolts to ensure leak tightness at the test pressure.
6. 08.00 **Vessels Supports / Lifting Lugs**
- 6.08.01 Adequate supporting arrangements like legs, straps, saddles, skirt boards, pillars etc. for the pressure vessels and atmospheric storage tanks shall be provided to transfer all loads to civil foundation. All foundation bolts, inserts etc. shall also be provided.
- 6.08.02 All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection.
- 6.08.03 All vessels of internal, diameter of 1200 mm or greater shall be provided with minimum four (4) lifting lugs for safe and effective handling during erection. Smaller vessels shall be provided with atleast two (2) lifting lugs.
- 6.08.04 Material of construction for these vessel supports, saddles, lugs shall conform to IS-2062.
6. 09.00 **Special Accessories for Tanks**
- 6.09.01 Each of all the tanks shall be provided with over flow connection designed for the filling rate of the respective tank.
- 6.09.02 Water Seal shall be provided for the overflow line of Demineralized Water Storage Tanks. Vent line of Demineralized Water Storage Tanks shall be provided with Carbon-Di-Oxide Absorber / Breather of proven design to prevent contamination from atmospheric air. Carbon-Di-Oxide Absorber / Breather shall preferably be located at finished floor / pavement level.
-

- 
- 6.09.03 The vent and overflow lines of Acid Bulk Storage / Day / Measuring Tanks shall be provided with fume absorber using suitable packing material, such as pall rings / raschig rings.
- 6.09.04 The vent and overflow lines of Alkali Bulk Storage / Preparation / Day / Measuring Tanks shall be provided with Carbon-Di-Oxide Absorber / Breather as addressed under clause no. 6.05.02 above.
- 6.09.05 Conservation Vent Valve shall provided on each of Demineralized Water Storage Tanks to ensure minimum contact with air. The valve should normally be closed. With vacuum or pressure to the extent of 65mm water gauge into the tank, the valve shall open to relieve the vacuum or pressure.

Material of construction should be as follows:

|                   |   |                     |
|-------------------|---|---------------------|
| Body & valve disc | - | Die cast aluminium. |
| Spindle           | - | Steel               |
| Spring            | - | Phosphor Bronze     |
| Seal              | - | Rubber              |

7.00.00 **ERECTION**

- 7.01.00 Each of all pressure vessels and atmospheric storage tanks should be directly placed on the civil foundation when supplied in fully fabricated form.
- 7.02.00 All fabricated part, before assembly, shall be transported by the Bidder to installation at site. All preliminary work and fabrication in part or full shall be done at the Bidder's fabrication yard or shop.
- 7.03.00 All material before final installation over the foundation at the respective locality shall be inspected and faired as necessary to ensure that any damage received during transportation is corrected before erection to the satisfaction of the Purchaser. Particular attention shall be given towards removal of buckles and other form of distortion in shell and bottom plates of vertical atmospheric storage tanks. Irregularities and dirt which would prevent metal to metal contact at the jointing faces shall be removed.
- 7.04.00 The method of holding the plates in position during welding and all devices used for this purpose should be approved by the Purchaser. All lap joints shall be held in close contact during welding and the surface in contact shall be thoroughly cleaned before assembly.
- 7.05.00 Holes in plate work to assist in erection should be avoided as far as possible. The location of the holes shall be indicated in the fabrication drawing. The method of filling holes shall be approved by the Purchaser. Lugs attached by welding to the tank and required only for the purpose of erection shall be removed and any projections of weld metal shall be chipped and grounded flush with the plate surface.
- 7.06.00 In the construction of the shell, every care shall be taken to minimize distortion or lack of circularity due to welding or for any other reason.
-

- 
- 7.07.00 Tanks shall be safeguarded against damage due to wind or any other external causes by providing suitable steel cable guys until completion.
- 7.08.00 All materials used by the Bidder such as electrodes, gaskets, bolts and nuts, paints and any other appurtenance shall be conforming to relevant Indian Standard Code of Practice or equivalent (subject to approval by the Purchaser). Manufacturer's test certificate for guaranteed performance shall have to be provided when called for.
- 7.09.00 The finished bottom plate of vertical atmospheric tanks shall be crowned from the outer periphery to the centre with a slope of 1:36. Sufficient number of plugged holes shall be provided in bottom plate of the tanks for bottom testing.
8. 00.00 **PROTECTIVE LINING AND PAINTING**
8. 01.00 Inside surfaces of all pressure vessels and atmospheric storage tanks shall be protected by anticorrosive paints or rubber lining as required / specified. External surfaces of all pressure vessels and atmospheric storage tanks shall be protected by anti corrosive painting.
8. 02.00 The supply and application of Protective Lining and Painting with reference to pressure vessels and atmospheric storage tanks need to be as per **Sub Section: M7 – Technical Specification for Protective Lining and Painting**, attached herewith.
9. 00.00 **TESTS AND INSPECTION**
9. 01.00 All pressure vessels shall be hydraulically tested at 1.5 times design pressure or 2 times the maximum working pressure whichever is higher, for a period not less than one (1) hour.
9. 02.00 All atmospheric storage tanks shall be tested for leak tightness by filling up with water up to the highest level for a period not less than 8 hours.
9. 03.00 Full rubber lining is to be tested as per IS-4682 Part I for the following tests:
- (a) Adhesion tests
  - (b) Tests to check resistance to bleeding
  - (c) Measurement of lining thickness
  - (d) Shore hardness test
  - (e) Spark test at high voltages 5 KV / mm of thickness with a gap of 8 mm between the probe and lining.
9. 04.00 Thickness of painting shall be checked with dry type thickness gauge.
9. 05.00 Vessels as per IBR shall be tested accordingly.
9. 06.00 DP test after back gauging and on complete welds on atmospheric tanks and pressure vessels need to be carried out.
9. 07.00 All non-destructive tests shall be carried out as per the applicable design code / standard for all pressure vessels and atmospheric tanks.
-

- 
- |          |                                                                                                                                                                                     |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9. 08.00 | Butt welds if any on the dished ends shall be radio graphed after dishing and shall be stress relieved.                                                                             |
| 9. 09.00 | All dished ends for pressure vessels shall be stress relieved after dishing.                                                                                                        |
| 9. 10.00 | All weld procedure and welder qualification certificates shall be verified.                                                                                                         |
| 9. 11.00 | All painting on vessels and tanks shall be checked for the thickness as per the specification mentioned elsewhere.                                                                  |
| 9. 12.00 | All materials to be used for the pressure vessels and atmospheric tanks and accessories should be of tested quality and test certificates shall be made available to the Purchaser. |

**CHAPTER 35: GENERAL REQUIREMENT FOR MISCELLANEOUS TANKS****35.1 General**

35.1.1 This section covers the design, supply of steel pipes and plates, structural steel and all accessories as required, paints and protective paintings as specified and as required, fabrication, erection, painting, testing of Fabricated & Miscellaneous Tanks with accessories as specified and associated civil works.

**35.2 Codes & Standards**

The design, manufacture and testing of tanks shall comply with the requirements of one or more of the following standards as applicable.

- 35.2.1 IS-805: Code of practice for use of steel in gravity water tank.
- 35.2.2 IS-816: Code of practice for use of metal arc welding for general construction in mild steel.
- 35.2.3 IS-9595: Metal arc welding of carbon and carbon manganese steels – Recommendations.
- 35.2.4 BS EN 12285-1&2: Workshop fabricated horizontal cylindrical steel tank.
- 35.2.5 IS-10987: Horizontal Cylindrical storage tank for Petroleum products.
- 35.2.6 IS-803: Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tanks.
- 35.2.7 IS-804: Code of practice for material, design, fabrication and erection of rectangular pressed steel tanks.
- 35.2.8 API-650: Welded Steel Tanks for Oil Storage

**35.3 Miscellaneous Steel Tanks : General Requirements**

35.3.1 The connections, accessories and fittings to be supplied with each tank shall be as specified and as required. The piping material required inside or outside up to the flanged terminal shall be supplied by the Contractor.

Tank connections shall be provided with suitable counterflanges with necessary bolts, nuts & gaskets by the Contractor.

35.3.2 The tank, where applicable, shall be complete with supporting structure, legs or pedestals, base plate, anchor bolts, nuts & sleeves etc. as required.

35.3.3 The special fittings, e.g. conservation vent valves, level indicators etc. shall also be supplied by the Contractor.

35.3.4 Preparation of detailed design, fabrication drawings, bill of materials, tag and piece numbers, welding procedure, etc.

Stiffeners where not specified and other structural framing for supporting tank shell shall be designed by the Contractor including supply of materials for the same.



- 35.3.5 This specification covers supply of steel plates, structural steel, pipes etc. as required.
- 35.3.6 The scope of work under this specification includes excavation and backfilling work required for installation of pipes running underground.
- 35.3.7 All pipe supports, thrust blocks, etc. as required will be properly designed and constructed by the Contractor in accordance with approved drawings. Necessary steel work at supports shall also be supplied, fabricated and erected by the Contractor.
- 35.3.8 The final fixing grout over the concrete support or through the opening left in the concrete work shall also be done by the Contractor.
- 35.3.9 The designer and manufacturer of storage tanks shall comply with and obtain approval of all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The tanks shall conform to IS 803 / IS 804 / IS 805 / IS 2825 / API 650 / IS 4049 / IS 4682 (part-I) and IS 4864 to 4870 / ASME B& PV code Sec.-VIII as the case may be

#### 35.4 DESIGN AND CONSTRUCTION

- (a) Design of all vertical atmospheric storage tanks containing water, acid, alkali and other chemical shall conform to IS: 803 & API 650.
- (b) Design of all horizontal atmospheric storage tanks containing water, acid, alkali and other chemicals shall generally conform to IS:2825 as regards to fabrication and general construction taking care of combined bending, shear & hoop stresses developed due to supporting arrangement.
- (c) Design temperature of vessels shall be 10 deg. C higher than the maximum temperature that any part of the vessel is likely to attain during the course of operation.
- (d) Tank shall be made from mild steel plates to BS 4350/IS-2062 Gr. B (or equivalent).
- (e) The joint efficiency factors to be adopted for design calculations shall be in accordance with the specified design code.
- (f) Tank shall be provided with suitable supporting joints. All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection.
- (g) The material for flanges shall be of ASTM A 105/IS-2062 Gr. B.
- (h) For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.
- (i) Vessel seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessel consisting of more than two sections longitudinal seams shall be offset.

- (j) Tanks shall be provided with float operated level indicators/level gauges/level transmitters and level switches, as required, with complete assembly. Suitable flanged pads for level switches mounting shall also be provided. The level indicator can be top or side mounted as the case may be.
- (k) In addition to inlet and outlet nozzles, the tanks shall be provided with vents, overflow, drain nozzles complete for various connections on tanks. Overflow lines from storage tanks is to be routed to the nearest surface drains. For tanks containing DM water, alkaline water or power cycle water the vent to atmosphere shall be through carbon-di-oxide absorber vessel suitably mounted on the tank. CO<sub>2</sub> absorber vessel shall be provided with the initial fill of chemicals. Similarly for equipment cooling water overhead tank, the overflow & drain from tank shall be combined together and shall be led to nearest drain (at zero level) via. a seal-trough so as not to come directly in contact with atmosphere.
- (l) Tanks shall have suitable stairs/ladders walking arrangement on inside and outside of the tanks, manholes/inspection covers as required and also platform suitably located.
- (m) Tank supporting arrangement as approved by Employer shall be provided with all plates/angles/joints/flats and supporting attachment including lugs, saddles, legs etc.
- (n) Piercing nozzles/pipes from tank body/dish ends shall be adequately compensated as per relevant code.
- (o) Tank fabrication drg. and design calculations shall be approved by the Project Manager.

### 35.5 Technical Requirements

- 35.5.1 Tanks shall be suitably constructed for safe, proper and continuous storage of liquid described. The design code, material standard, minimum plate thickness, size and other details shall be as per the specified Codes and Standards as applicable.
- 35.5.2 For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.
- 35.5.3 Vessel seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessels consisting of more than two sections, longitudinal seams shall be offset.
- 35.5.4 Where possible, the inside seam weld shall be ground smooth, suitable for application of corrosion resistant primer.
- 35.5.5 Due consideration for wind load and/or earthquake effect shall be given by the Contractor in the design of tanks. Data for wind load and earthquake shall be taken as indicated in the Project Information of this specification. Maximum allowable stresses for design loadings combined with wind or earthquake shall not exceed 133% of stress permitted for the design loading condition but in no case shall exceed 80% of specified minimum yield strength of the material.



- 35.5.6 Except where otherwise indicated in the Purchaser's drawings/ specifications, if the stiffening of the shell and/or roof is necessary the same shall be stiffened from outside.
- 35.5.7 Reinforcement pads in tank connections shall be provided as per applicable code & the reinforced connection shall be completely preassembled into a shell plate. The completed assembly including the connection shall be thermally stress-relieved as per API Standard 620 if specified.
- 35.5.8 All welding shall be done as per IS-816, IS-817 and IS-9595, latest revision as applicable. All welds are to be continuous welds. Bidder shall clearly state in his offer the make and type of welding rods proposed by him for fabrication. Inspection of welding shall be carried out in accordance to IS-822 and IS-9595. Welding sequence shall be adopted in such a way so as to minimise the distortion due to welding shrinkage, Contractor shall indicate in his Drawing the sequence of welding proposed by him which should meet prior approval of the Purchaser/Consultant.

**35.6 Tank Connections**

- (a) Bidder shall furnish all piping material required for the tank connections.
- (b) Unless otherwise specified, for all flanged connections Bidder shall furnish suitable counterflanges and the necessary nuts, bolts, gaskets etc.
- (c) Flange faces of all nozzles shall be machined and square with the vessel centrelines.
- (d) Unless otherwise stated, bolts and nuts shall be of hexagonal head conforming to IS-1357, latest revision.
- (e) The material and thickness of gaskets shall be suitable for the specified service. On completion of hydraulic test, Contractor shall replace the gaskets used during testing at his own cost.
- (f) All tanks shall be provided with connections for drains, vents and overflow.

**35.7 Accessories**

The tanks shall be provided with following minimum accessories as indicated in the Specification. All the accessories shall conform to relevant Indian Standards.

- a) **Level transmitter**  
SMART (HART) type D.P. level transmitters shall be provided for continuous level measurement as well as for alarm/Interlock (wherever applicable).
- b) **Level gauge**  
Reflex type Gauge Glass shall be provided at each tank.
- c) Where the tank height exceeds 2 M, vertical ladder is to be provided with cage.

- d) Top Manhole shall be provided in all tanks. Manhole size shall be 600 mm NB (minimum).
- 35.8 When installation of tank is specified the recommendation regarding installation in BS EN 12285-1 & 2 shall be followed in general. In addition to those recommendations, the following shall also be taken care of.
- 35.9 The finished tank grade for cylindrical tank shall be crowned from the outer periphery to the centre with a slope. The sloping factor shall be taken as 1:35 unless otherwise specified.
- 35.10 Welding shall be done in accordance with IS-816, IS-817, IS-822 & IS-9595.
- 35.11 Welding sequence shall be adopted in such a way so as to minimise the distortion due to welding shrinkage. Contractor shall indicate in his drawing the sequence of welding proposed by him which should meet prior approval of the Engineer.
- 35.12 **Corrosion Protection**
- (a) A corrosion allowance, applicable to surface in contact with corrosive media, when required, shall be taken into consideration.
- (b) Manholes shall be provided for easy access into the vessels. The size shall be minimum 500 mm and will be with cover plate, nuts bolts, etc. to ensure leak tightness at the test pressure.
- (c) Each tank shall be provided with drilled cleats welded to the tank for electrical grounding. Material of cleats shall be same as that of the shell.
- (d) Epoxy-coating shall be provided on the inside of vessel in three coats (minimum) resulting in total thickness of not less than 150 micron in which ever case required, such as equipment cooling water overhead tank, sodium hydroxide tank, condensate storage tank, condensate surge tank etc.
- 35.13 **Cleaning & Painting**
- (a) Inside surface of all tanks shall be protected by anti-corrosive paints as required.
- (b) For tanks/vessel requiring epoxy painting, all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- (c) Outside surfaces of all vessels shall be provided with two coats of primer with three (3) coats of epoxy resin based paint of approved color.

**34.0 GENERAL REQUIREMENTS HORIZONTAL AND VERTICAL WATER SERVICE PUMPS****34.1 SCOPE**

General requirements in respect of design, material, constructional features, manufacture, inspection, testing the performance at the Vendor's/ Sub-Vendor's works and delivery to site erection, field testing and commissioning of Horizontal Centrifugal Pumps.

**34.2 CODES AND STANDARDS**

Design, material, construction manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment supplied shall comply with the latest applicable Indian standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

**34.2.1 List of Applicable Standards**

- i) IS : 1520 - Horizontal Centrifugal Pumps for clear cold fresh water.
- ii) IS : 5120 - Technical requirements of roto-dynamic special purpose pumps
- iii) API - 610 - Centrifugal pumps for general refinery service.
- iv) IS : 5639 - Pumps Handling Chemicals & corrosion liquids.
- v) IS : 5659 - Pumps for process water
- vi) HIS - Hydraulic Institute Standards; USA
- vii) ASTM-I-165-65 - Standards Methods for Liquid Penetration Inspection.
- ix) IS-1710/1989 - Vertical Turbine Pumps for Clear, Cold and Fresh Water.

In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

**34.3 DESIGN REQUIREMENTS**

The maximum efficiency of pumps shall be preferably within + 10% of the rated design flow indicated in data sheets.

Total head capacity curve shall be continuously rising from the operating point towards shut - off without any zone of instability and with a minimum shut off head of 15% more than design head.

Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation.

| Speed              | Antifriction bearing | Sleeve bearing |
|--------------------|----------------------|----------------|
| 1500 rpm and below | 75.0 micron          | 75.0 micron    |
| 3000 rpm           | 50.0 micron          | 65.0 micron    |

The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1M from the equipment surface.

The pumps shall be capable of starting with discharge valve fully open and close condition.

### 34.4 DESIGN CONSTRUCTION

#### 34.4.1 Horizontal Pumps

Pump casing shall have radially/axially split type construction. The casing shall be designed to withstand the maximum shut - off pressure developed by the pump at the pumping temperature.

Pump casing shall be provided with a vent connection and piping with fittings & valves Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pr. Gauge as standard feature.

#### Impeller

Impeller shall be closed or semi-closed as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying pinning or lock rings.

#### Impeller/ Casing Wearing Rings

Replaceable type wearing rings shall be provided at suitable locations pumps. Suitable method of locking the wearing ring shall be used.

#### Shaft

The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

#### Shaft Sleeves

Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening shaft and shaft sleeve assembly should ensure concentric rotation.

#### Bearings

Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble - free operation shall be furnished.

The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Anti-friction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hours of continuous operation at maximum axial and a radial loads and rated speed.

Proper lubricating arrangement for the bearings shall be provided such that lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearing assembly.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearing housing.

#### **Stuffing Boxes**

Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standard. If external gland sealing is required, it shall be done from the pump connection.

#### **Mechanical Seals:**

Wherever specified in pump data sheet, mechanical seals shall be provided. The sealing face should be highly lapped surfaces of material known for their low frictional co-efficient & resistance to corrosion against the liquid being pumped.

#### **Pump and Motor Shaft Coupling**

The Pump and motor shaft shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor.

#### **Base Plate**

A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be of fabricated steel and of rigid construction, suitable ribbed and reinforced.

#### **Assembly and Dismantling**

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

### **34.4.2 For Vertical Pumps**

Pumps shall be of vertical shaft, complete with bowl, column pipe, discharge head and base plate with all accessories, as applicable. General design and constructional features of the pumps shall be as follows:

#### **Bowl Assembly**

This will be either a single or multi-stage centrifugal, mixed flow or axial flow type with discharge co-axial with shaft. Type of impeller shall be chosen on the basis of the pump specific speed and the characteristics of the handling fluid.

Pump(s) shall have provision for adjustment of impellers in vertical direction from an accessible location, preferably at the housing (where separate thrust bearing for the pump is provided). The adjustment mechanism must take into consideration the extension of the line shaft due to hydraulic down thrust, weight of the shaft and impeller.

**Discharge Head**

Pump(s) shall be either above floor or below floor discharge type, as specified in the specification, attached to this section.

In case, expansion joint is to be used at the pump discharge, pump base plate shall either be adequately designed to take the unbalanced forces and moments from the use of such expansion joint or a separate thrust block at the pump discharge head shall be provided to transmit these forces to the external supporting structure. Calculation of thrust load shall be done considering the highest pressure seen by the pump and internal diameter of the arch of the expansion bellow.

**Column pipe**

Column pipe shall be flanged and of bolted connection. Column pipes shall be designed for full internal vacuum.

In case the specification asks for the pump with below floor discharge, and the water level is at or above the discharge valve level, the column pipe piece located at the intermediate floor level shall be provided with suitable floor sealing device.

In case of multi-piece column pipe and shaft assembly, the design shall permit raising/lowering of the pump assembly piece by piece without any difficulty. Any fixtures, clamps, etc. necessary for such purpose shall be supplied by the Contractor under this section. The Contractor shall also submit a write-up describing clearly the procedure of handling the pump.

**Impeller shaft, line shaft and head shaft**

Shaft size shall be selected on the basis of maximum torque to be applied on the pump shaft.

Critical speed of the shaft shall be sufficiently away from the pump operating speed and in no case shall lie between 90% and 110% of the rated speed.

Impeller shaft shall be guided by bearings provided in each bowl or above and below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft shall be chamfered at the edges.

Line shaft may be of single or multiple pieces as required. In case of multiple pieces, line shaft shall be coupled as per the standard practice of the manufacturer.

For screwed coupling, screw directions shall permit tightening of the joint during pump operation.

Replaceable shaft sleeves shall be furnished at applicable locations, particularly under stuffing box and at other locations, as considered necessary.

**Shaft enclosing tube**

Shaft enclosing tube shall be required, unless self lubricated (and cooled) type of shaft bearings is asked for. Length of the shaft enclosing tube shall be in conformity with the shaft piece lengths.

**Seal rings**

Replaceable seal/wear rings both on impeller and on casing shall be provided in case it is asked for.

**Bearings****Shaft bearings**

Adequate number of properly designed bearings shall be provided for smooth and trouble-free operation of the pump. Number of bearings shall consider the number of shaft pieces used and the critical speed of the shaft. Bearings shall be either lubricated by external clear water/oil/grease or self lubricated as specified in the Specification.

In case of external water/oil lubrication, complete lubrication arrangement shall be furnished with the pump. If the specification calls for prelubrication of the shaft bearings, prelubrication tank and other accessories shall be within the scope of supply of the Bidder/Contractor.

**Thrust Bearing**

Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and dead weight of the rotating components. Life of the thrust bearing shall be guided by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load.

Thrust bearings shall be either grease or oil lubricated. Lubrication arrangement shall be such that the lubricant does not contaminate the handling fluid. The arrangement shall also be adequate to protect the bearing, while the pump coast down to stop in case of power failure of the station. Pre-lubrication of the thrust bearing, if recommended by the pump manufacturer, shall be taken care of in designing the lubrication system.

Cooling of the thrust bearing, if necessary, shall be done by the handling fluid / external water, depending on the fluid handled.

Location of the thrust bearing may be at the pump body or at the driver, or at both depending on the requirement of specification or as per the recommendation of the pump manufacturer (and approved by Purchaser).

**Reverse Rotation**

If the specification calls for, the pump impeller and other rotating components shall be designed for reverse rotation, when subject to reverse flow at rated pump discharge head.

**34.5 Drive Motor (Prime Mover)**

The KW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps is specified, the actual motor rating is to be selected considering overloading of the pump in the event of tripping of operating pumps. Continuous motor rating (at 50 deg. Cent, ambient) for pump shall be at least 15% above the maximum load demand of the driven equipment in the complete range.

**Annexure - A**  
**SUBMERSIBLE PUMPS****SCOPE**

This specification covers general requirements in respect of design, material, manufacture, construction, testing & inspection at Vendor's / sub-vendor's delivery to site, of submersible pumps.

**CODES AND STANDARD**

The design manufacture and performance of submersible pumps shall be comply with all currently applicable statues, regulation, and safely codes in the locality where the Equipment will be installed. The Equipment shall also conform to the latest applicable Indian standards listed below/equivalent standards.

**List of Applicable Indian Standards**

- IS: 8034 - Submersible pumps for clear cold fresh water  
IS: 5120 - Technical requirement of Rotodynamic Special Purpose pumps.

In case of any contradiction with aforesaid standards and the technical specification requirements, the stipulation of the technical specification shall prevail.

**DESIGN AND PERFORMANCE REQUIREMENTS**

- a) The pump shall be of single stage mono - block type with non-clog design.
- b) Components of Identical pumps shall be interchangeable.
- c) Pumps shall have continuously rising head characteristics.

**MOTOR RATING**

Continuous motor rating (at 50 deg. C ambient) for pumps shall be at least fifteen percent (15%) above the maximum load demand of the driven equipment in the complete operating range to take care of the system frequency variations.

**FEATURES OF CONSTRUCTION**

- a) Pumps shall be of Submersible, wet pit type.
- b) Pumps shall be able to pass through solids upto 20 mm and capable of handling waste water which may contain, sludge, plastic solids etc.
- c) Coupling device shall ensure leak proof joint between the pump and discharge elbow. This shall also enable pump to be removed from the sumps without the necessity of dismantling any nuts, bolts etc.
- d) Pumps shall be portable type and capable of using in any sump as and when required. Pump shall be provided with required stool, flexible, hose chain connection etc. for easy installation, removal and maintenance. Adequate length of chain required for lowering the pump into the sump and flexible type discharge pipe shall be provided.
- e) Impeller

The Impeller shall be as indicated in Data Sheets in this Sub-section. Enclosed impellers shall be equipped with seal rings on their hubs. In case of open impeller, the pump shall be design to take care of the additional thrust produced.

**32.0 MISCELLANEOUS PUMPSETS****32.1 GENERAL INFORMATION**

32.1.1 Sump pumps specified hereinafter shall be used to dewater various sump pits in various plant areas like BTG area, Plant Water System, Ash Handling plant etc. where gravity draining is not be envisaged and to ensure general housekeeping

32.1.2 Pumps under this specification have been divided into following three (3) groups according to different duty envisaged and location of sumps/pits.

**32.1.2.1 Group - A**

The Group - A pumps shall be electric motor driven permanently installed vertical wet pit bottom suction volute type and shall handle drainage water, containing solid particles with sludges, polluted liquid, oils etc. from the area where they are installed. These pumps shall run intermittently by the use of high and low level switches in the sump. Particle size in the water shall not normally exceed 15mm.

Group-A pumps shall also be provided to all indoor sumps of the plant and outdoor sumps of capacity 5 cu.m and above and underground cable vaults (if any) under the scope of this specification.

**32.1.2.2 Group - B**

These pumps shall be horizontal centrifugal electric motor/diesel engine driven portable type. Each pump set along with control panel etc. shall be mounted on a trolley for ease of transportation. These pumps shall be suitable for dewatering of pipelines of large diameter, if required and alike jobs and handling of liquids containing hard solid particles, sludge, polluted liquid, significant amount of fuel oil/LDO etc. and particle size shall not normally exceed 20 mm. These types of pumps shall be used in different plant areas.

**32.1.2.3 Group - C**

The Group - C pumps shall be vertical submersible portable type pump motor sets with suitable arrangement for carrying to any place and for lowering to and raising from various water reservoirs and pits. The pump motor set shall be suitable for handling water containing mud/sludge, solid particles, cotton waste, silica, ash particles, coal particles, polluted liquid etc. The particle size in water shall not exceed 20 mm. These pumps shall be utilised to dewater various deep sumps/pits (e.g. C.W pump house) in case of any eventuality.

**32.2 CODES AND STANDARDS**

32.2.1 The design, manufacture and performance of the sump pumps and drives specified, hereinafter, shall comply with the requirements of all applicable codes, the latest applicable Indian/British/American/DIN Standards, in particular the following:

32.2.2 IS-1710 : Vertical Turbine Pumps for clear cold and fresh water.

- 32.2.3 IS-5120 : Technical Requirements – Roto-dynamic special purpose pumps.
- 32.2.4 IS-5600 : Sewage and drainage pumps.
- 32.2.5 Hydraulic Institute Standards of USA.
- 32.2.6 The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards.

### 32.3 GENERAL PERFORMANCE REQUIREMENT

- 32.3.1 The pumps shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the "Range of Operation" as stipulated by the manufacturer.
- 32.3.2 Pumps shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum head being at shut off.
- 32.3.3 Permanently installed vertical pumps shall be suitable for parallel operation. The head vs capacity, the bhp. vs capacity characteristics etc. shall match to ensure equal load sharing and trouble free operation throughout the range. Drive Motor shall not be overloaded when pump discharge is more than rated condition.
- 32.3.5 The static head requirement of portable submersible type sump pump may have a considerably wide range of variation depending upon the depth of pit being dewatered. While the pump shall have adequate capacity at the maximum head, the motor shall be sufficiently rated to cater for any overloading during the pump operation at its minimum possible head, i.e., maximum discharge.
- 32.3.6 Pump motor set shall run smooth without undue noise and vibration. Acceptable peak to peak vibration limits shall generally be guided by Hydraulic Institute Standards (latest edition).

### 32.4 SCOPE OF WORK

- 32.4.1 Pumps under groups A, B and C as listed in the Annexure- I along with drive units, couplings and other accessories mentioned below, as also those needed to make the pump-motor sets complete in all respect, for proper operation and maintenance. All motors in outdoor duty shall be provided with IP-55 enclosure and canopy. In addition to the accessories listed in Annexure-I, each pump set shall also include the following:

#### 32.4.2 For the vertical Group - A sump pump motor sets

Three (3) nos. capacitance level switches per sump; one for low level, the second for high level and the third for very high level, along with necessary junction box, local control panel, control cables etc. to achieve automatic starting/stopping of the sump pumps, and also ON/OFF indication for sump pump shall be monitored at DDC system. The entire assembly being mounted on the same base frame as mentioned above (item "b"). The control panel shall also be equipped with start/stop push button for starting/stopping

individual sump pumps manually. Local control panel and cable shall be as per requirements described else where in the specification.

#### 32.4.3 For each of the trolley mounted horizontal Group-B sump pump motor sets/pump-Diesel Engine sets

- a) One (1) no. 7.5 meters long hose for the pump suction and one (1) no.30 meters long hose for the pump discharge, either ends of each hose being provided with female hose coupling.
- b) One (1) no. 500 mm long straight pipe piece, with both ends flanged, one end matching with the pump suction nozzle.
- c) Two (2) nos. male type hose couplings, one of which is suitable for coupling with the above mentioned 500 mm pipe piece on one side and the 7.5 meters long suction hose on the other side, whereas the other is suitable for coupling with the pump discharge nozzle on one side and the 30 metres long hose on the other side. The pump suction pipe-piece and discharge nozzle shall be of flanged type. As such each coupling end that is to match with the pipe/pump nozzle shall also be flanged and shall be equipped with necessary bolts, nuts & gaskets.
- d) A foot valve (of Bidder's recommended size) with suction strainer, necessary coupling and matching piece/reducer (if necessary) to couple with the 7.5 meter long suction hose end.
- e) A starter panel complete with incoming switch/contacter, fuse, overload relays, start-stop push button, O/L reset push button, cable gland, wiring terminals, red and green indication lamps (LED type), necessary control cables etc., and also 50 metres length of flexible power cable with power plug at one end and arrangement to connect the other end with the starter panel.
- f) The pump motor set with a baseframe along with the starter panel, power cable, suction & discharge hoses etc., as mentioned above, shall be mounted on a suitable trolley with swivelling front wheel and having adequate fixing arrangement for all equipment, for operation without any undue vibration and with facility for being handled by a single operator.

#### 32.4.5 For each of the portable submersible Group-C sump pump motor sets.

- a) Two (2) nos. 30 metres long discharge hose, having female hose coupling at both ends.
- b) One (1) no. 500 mm long pipe piece with both ends flanged, one end connected by necessary bolts, nuts & gaskets with the flanged discharge nozzle of the sump pump.
- c) One (1) no. male type hose coupling, one end of which is suitable to couple with the discharge hose and the other end is flanged, matching with the above mentioned 500 mm long pipe end and connected therewith by necessary bolts, nuts & gaskets.
- d) Suitable attachment for temporary seat of the pump motor set on the floor at sump bottom.

- e) One (1) no. 25 metres long submersible type power cable having a power plug at one end and a hermetically sealed (waterproof) cable gland for connection with the pump drive- motor at the other end.
- f) Suitable lugs and other attachments on the pump motor assembly frame, for hoisting and lowering of the pump motor set from and to the sump.
- g) One starter panel, having a plug socket as receptacle of the above mentioned power plug (item "e"), a 25 metre long incoming power cable with switch/contacter and fuse, start- stop push buttons, red and green LED type indication lamps, over load relays, O/L reset push button, cable gland etc., and also a suitable arrangement for temporarily mounting the starter panel, near the sump, where the portable sump pump-motor set is to work. The incoming 25 metre long power cable shall also be provided with a suitable power plug at one end.

32.4.6 Lubrication of one (1) initial fill and one additional fill after commissioning.

32.4.7 Rust inhibitor paint at Manufacturer's works.

### 32.5 DESIGN AND CONSTRUCTION

32.5.1 The design, construction testing and other details of the sump pumps and related accessories shall be in line with the stipulations and data in this chapter.

32.5.2 Each sump pump shall be equipped and coupled with a drive motor, with rating so selected as to have at least 15% margin over the maximum power required by the pump, throughout its range of operation. All other requirements of the drive motors shall be as stipulated in the Electrical Specification Vol III, Part B.

The discharge rate of sump pump is uncontrolled. As such pump should be capable to operate even under a condition of as low as 25% of specified total head. Motors of group-B pumps should be designed to cater such eventuality.

32.5.3 All electrical items shall conform to the stipulations of Electrical Specification Vol IV as applicable.

32.5.4 All piping shall be as per IS-1239 of medium or heavy grade (as suited for the maximum operating pressure) and shall be either galvanised or painted with approved rust inhibiting paint. Pipe size shall be as per Appendix-II. Any matching piece/reducer required to match the pipe with pump nozzle, hose, etc. shall be provided.

32.5.5 All valves shall be steel body type as per applicable IS/BS/ANSI standard, with pressure class compatible with the maximum working pressure.

32.5.6 All hoses shall be of steel wire reinforced type. Pump suction hose shall be suitable for working under vacuum. Pump discharge hose shall be suitable to withstand the maximum pressure that it may be subjected to in all

working conditions, including hydrostatic testing of the sump pump discharge line.

- 32.5.7 Pump suction strainer shall have openings large enough just to permit the entry of solids having maximum size as stipulated under clause no. 1.02.00.

### 32.6 Pumps

- 32.6.1 Pumps under Group-A shall be wet pit type, vertical shaft, centrifugal, vertical submerged suction, non-clog volute type complete with enclosed shaft, discharge pipe, head assembly thrust bearing and drive assembly, cover plates etc.

- 32.6.2 Pumps under Group-B shall be of horizontal shaft, single stage, end suction, radially split casing, centrifugal, non-clog design complete with common base plate, drive assembly etc. These pumps shall be trolley mounted portable type.

- 32.6.3 Pumps under Group-C shall be submersible pump-motor type, single stage and non-clog design and shall be portable type.

### 32.7 Casing

- a) Casing shall be so designed to allow free passage of specified maximum size of solid.
- b) Casing shall be designed to withstand the maximum shut-off pressure developed by the pump.
- c) The casings shall be cast, free from blowholes, sand holes, other detrimental defects. The casing shall be complete with suction and discharge connections.
- d) For pumps under Group-A adequate seal arrangement shall be made to keep leakage of liquid from casing to column assembly to minimum and adequate drain shall be provided in column assembly to permit escape of the leakage flow. The casing shall also include the bearing housing of the bottom pump shaft bearing.
- e) Casing of pumps under Group-B shall be provided with vent connections and drain connections with valves. These pumps shall be manually primed.

### 32.8 Impeller

- a) The impeller shall be open/semi-open non clog type, cast in one piece and specially designed to pass large solids or unscreened liquids. The clearance between stationary and moving parts should be such as to allow sustained performance without exclusive maintenance.
- b) Impellers of pumps under Group-A shall have provision for adjustment from an accessible location and for pumps under Group-C shall be capable of passing fibrous material like cotton waste, jutes, etc.

**32.9 Pump Shaft**

- a) Shaft size selected shall be such that critical speed is at least 20% away from the operating speed and the runaway speed.
- b) The shaft shall be ground and polished to final dimension and of ample size to withstand all stresses resulting from rotor weight, hydraulic loads and across the line starting. Shaft shall be provided with renewable sleeves particularly under stuffing boxes and other locations as recommended by pump manufacturers.
- c) The coupling between shafts shall be so designed that they become tight during pump operation.

**32.10 Column Pipe (for pumps under Group-A)**

The discharge pipe shaft assembly shall be flanged or screwed as per manufacturer's standard and standard length of each piece of column pipe shall be in conformity to the shaft piece lengths from consideration of easy handling.

**32.11 Bearings**

- a) Adequate nos. of properly designed bearings shall be furnished. Bearings for pumps shall be antifriction type and lubricated by grease. Line shaft bearings of vertical pumps shall also be grease lubricated. All necessary grease gun, grease cup and tubing shall be included.
- b) Thrust bearing of adequate design shall be furnished for taking the entire pump thrust arising from all probable conditions of continuous operation through out its "range of operation" and also the shut-off condition. The life of thrust bearing shall be 20,000 working hour minimum for the load corresponding to the duty point. The bearings shall be lubricated by grease from a location conveniently accessible. Design shall be such that the lubricant cannot contaminate the handling liquid.

**32.12 Wearing Ring / Liner Plate**

Renewable wearing rings/liner plates shall be provided either on impeller or on the casing or on both impeller and casing.

**32.13 Stuffing Box**

Stuffing Box of pumps under Group-A shall be of mechanical packing type. For pumps under Group-B and Group-C mechanical seal of reliable design shall be provided.

**32.14 Coupling**

Pump and motor shall be connected with a suitable flexible coupling. Coupling shall be provided with coupling guard.

**32.15 Mounting Plate for Group-A Pumps and Base Plate for pumps under Group-B.**

Each pump under Group-A shall be provided with a suitable mounting plate. The mounting plate shall be adequately sized to accommodate the level switches, discharge pipe, grease cups etc. if any. Pumps and motor under Group-B shall be mounted in one base plate. Base plate shall be of rigid construction properly ribbed as needed. Suitable drain with valve and drain funnel shall be furnished by the Bidder.

The necessary supporting plate, mounting frame, base plate etc. as required shall be supplied under this specification, along with anchor bolts, foundation bolts, pipe, sleeves etc. Lifting lug, eyebolts, etc. as required for the proper handling of each pump set shall be furnished.

**32.16 Suction Bell**

The pumps under Group-A, C shall be complete with adequately dimensioned suction bell to guide and streamline intake fluid.

**32.17 Material of Construction**

For material of construction of various parts of data specification sheet shall be referred to.

**32.18 INSPECTION AND TESTING**

32.18.1 All pumps shall be tested at the shop for capacity, head, efficiency and brake horse power. These tests are to be done according to the requirements of "Hydraulic Institute Standard".

32.18.2 The pump integral accessories like thrust bearing, pump motor coupling etc. shall be subject to tests as per manufacturer's standard.

32.18.3 Test on motors, control panels, starter panels, cables shall be conducted as per the requirement of Vol.IV of this specification and as per Quality Assurance Plan to be approved by Owner during detail engineering.

32.18.4 After delivery/erection at site, pumps shall be operated to prove satisfactory and trouble free performance.

**32.19 DRAWINGS, DATA, INFORMATION REQUIRED**

32.19.1 Location and dimension of all sumps which requires assisted evacuation, present in the areas covered under the scope of this specification.

32.19.2 List of location of Group-A .

32.19.3 Characteristic curves of pumps showing effective head, pump input power, efficiency, submergence and NPSH, against capacity ranging from shut-off condition to 125% or rated capacity for Group A, B pumps and to 150% of rated capacity for Group C pumps.

- 32.19.4 Speed vs. torque curve of the pump corresponding to recommended mode of pump starting, super-imposed on speed vs. torque of the motor, corresponding to 80% and 100% rated voltage.
- 32.19.5 Diagram showing the type of lubrication system etc.

## DATA SHEET – MISCELLANEOUS PUMPSETS

| S. No. | Description                                | Group A                                                                                                                                                                                | Group B                                                | Group C               |
|--------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-----------------------|
| 1      | Pumps                                      |                                                                                                                                                                                        |                                                        |                       |
| 1.1    | Rated Capacity                             | Capacity of each pump should be so selected to empty sump pit in 10 to 15 minutes                                                                                                      | Twenty (20)                                            | Fifty (50)            |
| 1.2    | Total Dynamic Head at rated Capacity (MLC) | To be calculated with 10% margin on frictional drop                                                                                                                                    | 15                                                     | 20                    |
| 1.3    | Minimum suction lift                       | -                                                                                                                                                                                      | 6                                                      | -                     |
| 1.4    | Nos. required                              | These pumps shall be provided in all indoor sumps and outdoor sumps of 5 cum & above and underground cable vaults and CW pumphouse. Pumps shall be of 2 x 100% capacity for each sump. | Four (4) (2 electric motor driven and 2 diesel engine) | Four (4)              |
| 1.5    | Duty                                       | Intermittent                                                                                                                                                                           |                                                        |                       |
| 1.6    | Pump design standard                       | IS 5120/ IS 1710/ HIS                                                                                                                                                                  |                                                        |                       |
| 1.7    | Parallel operation                         | Yes                                                                                                                                                                                    | No                                                     | No                    |
| 1.8    | Material of Construction                   |                                                                                                                                                                                        |                                                        |                       |
| a)     | Base Plate/ Cover Plate                    | MS – IS 2062                                                                                                                                                                           | MS – IS 2062                                           | MS – IS 2062          |
| b)     | Column Pipe                                | MS – IS 2062                                                                                                                                                                           | MS – IS 2062                                           | MS – IS 2062          |
| c)     | Casing                                     | 2% NiCi                                                                                                                                                                                | 2% NiCi                                                | 2% NiCi               |
| d)     | Impeller                                   | 2% NiCi                                                                                                                                                                                | 2% NiCi                                                | 2% NiCi               |
| e)     | Pump/ Impeller Shaft                       | SS 410                                                                                                                                                                                 | SS 410                                                 | SS 410                |
| f)     | Shaft Sleeve                               | SS 410                                                                                                                                                                                 | SS 410                                                 | SS 410                |
| g)     | Shaft Coupling                             | SS 410                                                                                                                                                                                 | SS 410                                                 | SS 410                |
| h)     | Shaft Bearing                              | BUSH GM as per IS 306                                                                                                                                                                  | BUSH GM as per IS 306                                  | BUSH GM as per IS 306 |
| i)     | Gland                                      | CI IS 210 FG 260                                                                                                                                                                       | CI IS 210 FG 260                                       | CI IS 210 FG 260      |
| j)     | Fasteners                                  | SS 304                                                                                                                                                                                 | SS 304                                                 | SS 304                |

|                                                                                   |                                                                  |                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
|  | TITLE:                                                           | SPECIFICATION NO. PE-TS-426-155-A001 |
|                                                                                   | 1 X 660 MW PANKI TPS EXTENSION PROJECT                           | SECTION - II                         |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>CONDENSATE POLISHING UNIT</b> | SUB-SECTION - II A                   |
|                                                                                   |                                                                  | REV.NO. 0 DATE:                      |

## TECHNICAL SPECIFICATION FOR HORIZONTAL CENTRIFUGAL PUMPS

|                                                                                   |                                                                  |                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
|  | TITLE:                                                           | SPECIFICATION NO. PE-TS-426-155-A001 |
|                                                                                   | <b>1 X 660 MW PANKI TPS EXTENSION PROJECT</b>                    | SECTION - II                         |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>CONDENSATE POLISHING UNIT</b> | SUB-SECTION - II A                   |
|                                                                                   |                                                                  | REV.NO. 0 DATE:                      |

## 1.00.0 SCOPE

- 1.01.0 This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.

## 2.00.00 CODES AND STANDARDS

- 2.01.0 The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

### 2.02.0 List of Applicable Standards.

|   |               |                                                               |
|---|---------------|---------------------------------------------------------------|
| 1 | IS : 1520     | Horizontal Centrifugal Pumps for clear cold fresh water.      |
| 2 | IS : 5120     | Technical requirements of roto dynamic special purpose pumps. |
| 3 | API : 610     | Centrifugal pumps for general refinery service.               |
| 4 | IS : 5639     | Pumps Handling Chemicals & corrosion liquids.                 |
| 5 | IS : 5659     | Pumps for process water.                                      |
| 6 | HIS           | Hydraulic Institute Standards, USA                            |
| 7 | ASTM-1-165-65 | Standards Methods for Liquid Penetration Inspection.          |

- 2.03.03 In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

## 3.00.00 DESIGN REQUIREMENTS

- 3.01.00 The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve over the operating range of 40% to 120% of the duty point. The maximum efficiency of pump shall be preferably be within +/- 10% of the rated design flow as indicated in the data sheets.
- 3.02.00 The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of 15% more than the design head.

|                                                                                   |                                                                  |                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
|  | TITLE:                                                           | SPECIFICATION NO. PE-TS-426-155-A001 |
|                                                                                   | <b>1 X 660 MW PANKI TPS EXTENSION PROJECT</b>                    | SECTION - II                         |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>CONDENSATE POLISHING UNIT</b> | SUB-SECTION - II A                   |
|                                                                                   |                                                                  | REV.NO. 0 DATE:                      |

3.03.00 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

3.04.00 Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

| SPEED              | Antifriction Bearing | Sleeve Bearing |
|--------------------|----------------------|----------------|
| 1500 rpm and below | 75.0 micron          | 75.0 micron    |

3.05.00 The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment.

3.06.00 The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.

3.07.00 The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

3.08.00 Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.

3.09.00 The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.

#### **4.00.0 DESIGN CONSTRUCTION**

4.01.00 Design and construction of various components of the pumps shall conform to the following general specifications. for material of construction of the components, data sheets shall be referred to.

#### **4.02.0 Pump Casing**

4.02.01 Pump casing shall have axially or radially split type construction. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.

4.02.02 Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

|                                                                                   |                                                                  |                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
|  | TITLE:                                                           | SPECIFICATION NO. PE-TS-426-155-A001 |
|                                                                                   | <b>1 X 660 MW PANKI TPS EXTENSION PROJECT</b>                    | SECTION - II                         |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>CONDENSATE POLISHING UNIT</b> | SUB-SECTION - II A                   |
|                                                                                   |                                                                  | REV.NO. 0 DATE:                      |

**4.03.00 Impeller**

- 4.03.01 Impeller shall be closed, semi-closed or open type, and it shall be designed in conformance with the detailed analysis of the liquid being handled.
- 4.03.01 The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.

**4.04.00 Impeller/Casing Wearing Rings**

- 4.04.01 Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.

**4.05.00 Shaft**

- 4.05.01 The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.
- 4.05.02 The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.

**4.06.00 Shaft Sleeves**

- 4.06.01 Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.
- 4.06.02 Shaft sleeve shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

**4.07.00 Bearings**

- 4.07.01 Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished
- 4.07.02 The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.
- 4.07.03 Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.

|                                                                                   |                                                                  |                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
|  | TITLE:                                                           | SPECIFICATION NO. PE-TS-426-155-A001 |
|                                                                                   | <b>1 X 660 MW PANKI TPS EXTENSION PROJECT</b>                    | SECTION - II                         |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>CONDENSATE POLISHING UNIT</b> | SUB-SECTION - II A                   |
|                                                                                   |                                                                  | REV.NO. 0 DATE:                      |

4.07.04 Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

#### **4.08.00 Stuffing Boxes**

4.08.01 Stuffing box design should permit replacement of packing without removing any part other than the gland.

4.08.02 Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.

#### **4.09.00 Mechanical Seals**

4.09.01 Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.

4.09.02 The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.

#### **4.10.00 Pump Shaft Motor Shaft Coupling**

4.10.01 The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

#### **4.11.00 Base Plate**

4.11.01 A common base plate mounting both for the pump and motor shall be provided. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.

#### **4.12.00 Assembly and Dismantling**

4.12.01 Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

|                                                                                   |                                                                  |                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
|  | TITLE:<br><b>1 X 660 MW PANKI TPS EXTENSION PROJECT</b>          | SPECIFICATION NO. PE-TS-426-155-A001 |
|                                                                                   |                                                                  | SECTION - II                         |
|                                                                                   |                                                                  | SUB-SECTION - II A                   |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>CONDENSATE POLISHING UNIT</b> | REV.NO. 0 DATE:                      |

**4.13.00 Drive Motor (Prime Mover)**

- 4.13.01 The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps are specified, the actual motor rating is to be selected by the tenderer considering overloading of the pumps in the event of tripping of operating pumps.

**5.00.00 TESTING FOR HORIZONTAL CENTRIFUGAL PUMPS**

The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with the requirement of applicable Codes and Standards. The particulars of the proposed tests shall be submitted to the Owner for approval before conducting the tests.

**5.01.00 Hydrostatic Tests**

All pressure parts shall be hydraulically tested at 200% of pump rated head or at 150% shut off head whichever is higher. The test pressure shall be maintained for 1/2 hr. and no leakage shall be permitted. While arriving at the above pressure, the maximum suction head specified in Data Sheet shall be taken into account.

**5.02.00 Performance Tests**

- 5.02.01 All the pumps shall be tested in the Manufacture's Works at rated speed for capacity, efficiency and brake horse power. Pumps shall be given running test over the entire operating range covering from the shut off head to the maximum flow. The duration of test shall be minimum one (1) hour. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standards or as applicable equivalent
- 5.02.02 The test shall be preferably conducted with the actual motor being furnished.
- 5.02.03 Only those pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and excessive vibration is observed during the performance test. Otherwise strip down examination is limited to bearing inspection only.
- 5.02.04 The pump accessories e.g. the thrust bearing, couplings etc. shall be subjected to tests as per manufacturer's standards.

**5.03.00 Mechanical Balancing**

All rotating components of the pumps shall be statically balanced. In addition to static balancing, rotating components of the pumps shall be balanced dynamically at or near the operating speed. Tenderer shall furnish acceptance norm for this test.

**5.04.00 Visual Inspection**

Pumps shall be offered for visual inspection by the bidder before shipment. The components of the pumps shall not be painted before inspection.

|                                                                                   |                                                                  |                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
|  | TITLE:                                                           | SPECIFICATION NO. PE-TS-426-155-A001 |
|                                                                                   | <b>1 X 660 MW PANKI TPS EXTENSION PROJECT</b>                    | SECTION - II                         |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>CONDENSATE POLISHING UNIT</b> | SUB-SECTION - II A                   |
|                                                                                   |                                                                  | REV.NO. 0 DATE:                      |

**5.05.00 NPSH Test**

NPSH test shall be conducted with water as medium if required. NPSH shall not be mandatory in case type test certificates are furnished for the similar rating of pumps.

**5.06.00 Noise and Vibration Measurement**

Noise and vibration shall be measured during the performance testing at shop as well as during the site test.

- 5.06.01 The noise level shall not exceed 85 dBA. Noise level measurement will be made as per applicable internationally acceptable standard. The measurement shall be carried out with calibrated integrating sound level meter meeting the requirement of IEC:651 or BS:5969 or IS:9779. Sound pressure level will be measured all round the pump and motor set at a distance of one meter from the nearest surface of the machine and at a height of 1.5 m from the floor level. A minimum of six (6) points should be covered for measurement. The measurement shall be done with a slow response on the A-weighted scale. The average of the A-Weighted sound pressure measurements expressed in decibels to a reference 0.0002 microbars shall not exceed the specified value.

The tests shall be carried out on the machine operating at rated speed and as near as possible to the rated power. Corrections for background noise and correction on account of test environment will be considered in line with applicable standard. For this purpose all the additional data required should necessarily be collected during the test.

- 5.06.2 Vibration check will also be done as per HIS. Vibration would be checked at thrust bearing locations on horizontal, radial and vertical direction. The acceptance limits would be as per HIS. The instrument used would be IRD 308 or equivalent with velocity pick-up. Vibration limits to be specified as per the speed of the pump.

**5.07.00 Material Test Certificate**

- 5.07.01 Material of the various pump components shall be tested in accordance with the relevant standards. Test certificates for these shall be furnished for the Owner's approval.
- 5.07.02 Where stage inspection is desired by BHEL/customer all material test certificates shall be correlated and verified with the actual material used for construction before starting fabrication by BHEL/customer's inspector who will stamp the material. In case mill test certificate for the material are not available, the supplier shall carry out physical and chemical tests at his own cost from a testing agency, approved by BHEL/Customer, as per the requirement of specified material standard. The sample for physical and chemical testing shall be drawn up in presence of BHEL/Customer's inspector who shall also witness the testing.

**5.08.00 Non Destructive Testing**

- (a) UT shall be carried out on shafts of diameter more than 50 mm.
- (b) DP tests shall be carried out on shaft and impeller.

|                                                                                   |                                                                  |                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
|  | TITLE:<br><b>1 X 660 MW PANKI TPS EXTENSION PROJECT</b>          | SPECIFICATION NO. PE-TS-426-155-A001 |
|                                                                                   |                                                                  | SECTION - II                         |
|                                                                                   |                                                                  | SUB-SECTION - II A                   |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>CONDENSATE POLISHING UNIT</b> | REV.NO. 0      DATE:                 |

- (c) No weld repair shall be allowed on cast iron.

#### **5.09.00 Field Testing**

- 5.09.01 After installation, the pumps offered shall be operated to prove satisfactory performance as individual equipment as well as a system run. If the performance at site is found not to the requirements then the equipment shall be rectified or replaced by the Vendor, at no extra cost to the Owner. The procedure of the above testing will be mutually agreed between the Owner and the contractor. Noise and vibration tests shall also be repeated at site.
- 5.09.02 Based on observation of the trial operation, if modifications and repairs are necessary, the same shall be carried out by the contractor to the full satisfaction of the engineer and then the performance and guarantee tests to be repeated at site as per relevant clauses of the specification.

|                                                                                   |                                                                  |                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
|  | TITLE:                                                           | SPECIFICATION NO. PE-TS-426-155-A001 |
|                                                                                   | 1 X 660 MW PANKI TPS EXTENSION PROJECT                           | SECTION - II                         |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>CONDENSATE POLISHING UNIT</b> | SUB-SECTION - II A                   |
|                                                                                   |                                                                  | REV.NO. 0                      DATE: |

## TECHNICAL SPECIFICATION FOR METERING PUMPS

|                                                                                   |                                                                  |                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
|  | TITLE:                                                           | SPECIFICATION NO. PE-TS-426-155-A001 |
|                                                                                   | <b>1 X 660 MW PANKI TPS EXTENSION PROJECT</b>                    | SECTION - II                         |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>CONDENSATE POLISHING UNIT</b> | SUB-SECTION - II A                   |
|                                                                                   |                                                                  | REV.NO. 0      DATE:                 |

**1.00.0 GENERAL**

- 1.01.01 Specification cover the design, material, construction features, manufacture, inspection, testing the performance at the vendor's/sub-vendor's works, delivery to site, erection, commissioning and testing of metering pumps.

**2.00.0 GENERAL DESIGN FEATURES**

- 2.00.01 Pumps shall be simplex positive displacement hydraulically operated diaphragm design, driven by squirrel cage induction motor through suitable speed reduction unit. Maximum pump stroke speed shall not exceed 100 per minute.
- 2.00.02 The stroke shall be continuously adjustable to give a capacity variation 0-100% range while the pump is running or stopped. Adjustment of capacity shall be done by manual control facility (micrometric adjusting type) to be provided locally for each of the pump.
- 2.00.03 The stroke shall be continuously adjustable to give a capacity variation 0-100% range while the pump is running or stopped. Adjustment of capacity shall be done by manual control facility (micrometric adjusting type) to be provided locally for each of the pump.
- 2.00.04 Capacity variation may be effected by changing eccentricity of the driving crank or by suitable hydraulic circuit. Pump accuracy shall be industry standard  $\pm 1\%$  of capacity setting.
- 2.00.05 Pumps shall be provided with an integral relief valve, spring operated to release pressure when delivery line blockage occurs.
- 2.00.06 Crankcase shall be constructed of high quality cast iron, which will also house the gearbox and guides of cross head.
- 2.00.07 Guided, controlled travel, double-ball check valves or equivalent, shall be provided both on the suction and discharge side.
- 2.00.08 Material of construction of the various parts shall be as per the details furnished elsewhere in the specification. However all parts coming in contact with acid shall be of Hastelloy 'B' and for alkali it should be of SS-316 only.
- 2.00.09 Suitable gland seal shall be provided to prevent leakage.
- 2.00.10 Electric drive motor particulars should follow enclosed electrical chapters.

**3.00.00 TESTING****3.01.00 Testing and Inspection at Manufacturer's Works**

|                                                                                   |                                                                  |                                      |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
|  | TITLE:                                                           | SPECIFICATION NO. PE-TS-426-155-A001 |
|                                                                                   | <b>1 X 660 MW PANKI TPS EXTENSION PROJECT</b>                    | SECTION - II                         |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>CONDENSATE POLISHING UNIT</b> | SUB-SECTION - II A                   |
|                                                                                   |                                                                  | REV.NO. 0      DATE:                 |

- 3.01.01 The manufacturer shall conduct all tests required to ensure that the equipment furnished conforms to the requirements of this Specification and is in compliance with requirements of the applicable codes. The particulars of the proposed tests and the procedures for the tests shall be submitted to Owner for approval before conducting the tests.
- 3.01.02 The Owner's representatives shall be given full access to all tests for which the Manufacturer shall inform the Owner allowing adequate time so that if the Owner so desires, his representatives can witness the test.
- 3.01.03 All materials and castings used for the equipment shall be of tested quality. The test certificates shall be made available to Owner.
- 3.01.04 The pump casing shall be hydraulically tested at 200% pump operating pressure or 150% of design pressure whichever is higher. The test pressure shall be maintained at least for ½ an hour.
- 3.01.05 The rotating parts of pump drive shall be subjected to static balancing.
- 3.01.06 All pumps shall be tested at the shop for capacity, volumetric accuracy, repetitive accuracy, power and volumetric efficiency. The tests are to be done according to the requirements of the "Hydraulic Institute" of U.S.A. and Indian Standards as applicable.
- 3.01.07 The pump accessories e.g. gear box, speed reduction unit etc. will be subjected to tests as per manufacturer's standards. The test results shall be furnished to the Owner.
- 3.01.08 The combined variation of the pump and motor should be restricted within limits specified by Hydraulic Institute Standard, USA when the pump operated singly or in parallel.
- 3.01.09 All pumps shall be subject to strip down examination visually to check for mechanical damages after performance testing at shop.
- 3.01.10 Diaphragm of the metering pump shall be type tested as per applicable code/standard.
- 3.01.11 Performance test shall be carried out for the setting of pressure relief valve.
- 3.01.12 Test reports and certificates of all the above-mentioned tests to ensure satisfactory operation of the system shall be submitted to the Owner for approval before dispatch.

### **3.02.00 Test at Site**

After erection at site pumps as detailed under different groups shall be operated to prove satisfactory performance as individual equipment as well as a system. If the performance at site is found to be not to the requirements, then the equipment shall be rectified or replaced by the Vendor at no extra cost to the Owner.

**Chapter 27: LP PIPING, VALVES & SPECIALITIES****27.0 LP PIPING, VALVES & SPECIALITIES****27.1 Equipment sizing Criteria**

27.1.1 All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.

27.1.2 For all LP piping system covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated elsewhere. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.

27.1.3 Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following.

**a) Water Application****Water Velocity in m/sec**

|    | Pipe Size                           | Below<br>50 mm | 50-150<br>mm | 200 mm<br>& above |
|----|-------------------------------------|----------------|--------------|-------------------|
| a) | Pump suction                        | -----          | 1.2 - 1.5    | 1.2 - 1.8         |
| b) | Pump discharge<br>and recirculation | 1.2-1.8        | 1.8 - 2.4    | 2.1 - 2.5         |
| c) | Header                              | ----           | 1.5 - 2.4    | 2.1 - 2.4         |

The pipes in CW, ACW & DMCW system shall be designed to maintain a maximum velocity of 2 m/s inside the pipelines at pump discharge.

Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value.

|      |                         |     |
|------|-------------------------|-----|
| i)   | Carbon steel pipe       | 100 |
| ii)  | CI Pipe/Ductile Iron    | 100 |
| iii) | Rubber lined steel pipe | 120 |
| iv)  | Stainless steel pipe    | 100 |

For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/sump/reservoir from which the pumps draw water.



**b) Compressed Air Application**

Compressed air – 15.0 m/sec. (under Average Pressure & Temp. conditions)

- 27.1.4 The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.
- 27.1.5 Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.
- 27.1.6 Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered.
- 27.1.7 Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.
- 27.1.8 High points in piping system shall be provided with vents alongwith valves as per the system requirement. Low points shall be provided with drains alongwith drain valves as per the system requirement. Drain lines shall be adequately sized so as to clear condensate in the lines. Material for drain and vent lines shall be compatible with that of the parent pipe material.
- 27.1.9 Material of construction for pipes carrying various fluids shall be as specified elsewhere.
- 27.1.10 Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.
- 27.1.11 Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.
- 27.1.12 Threaded joints shall be provided with Teflon sealant tapes.
- 27.1.13 Following types of valves shall be used for the system/service indicated.

| System         | Type of Valves |      |       |       |      |      |
|----------------|----------------|------|-------|-------|------|------|
|                | Butterfly      | Gate | Globe | Check | Ball | Plug |
| Water          | X              | X    | X     | X     | X    |      |
| Air            |                | X    | X     | X     | X    |      |
| Drains & Vents |                |      | X     | X     | X    |      |
| Fuel oil       |                | X    | X     | X     | X    | X    |

In water service, valves above 200 NB size may be butterfly valves.

- 27.1.14 Recirculation pipes alongwith valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30% design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.
- 27.1.15 All Piping 450 NB & Above shall be designated as Large dia Piping.
- 27.2.00 TECHNICAL SPECIFICATION**
- 27.1.00 GENERAL**
- Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers/supports, tanks etc.
- 27.2.00 Pipes and fittings**
- 27.2.1 All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness shall be adhered to. The bidder shall furnish the pipe sizing / thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.
- 27.2.2 Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.
- 27.2.3 Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.
- 27.2.4 Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).
- 27.2.5 The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/expansion joint etc. shall be provided as may be necessary depending on layout.

- 27.2.6 Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.
- 27.2.7 For rubber lined ERW pipes, beads shall be removed.
- 27.2.8 Inspection holes shall be provided at suitable locations for pipes 800 NB and above as required for periodic observations and inspection purposes.
- 27.2.9 At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.
- 27.2.10 For large size pipes/duct, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code.

Transient analysis / surge analysis wherever specified and required shall be conducted in order to determine the location, number and size of the Air-Release valve on certain long distance/high volume piping systems such as CW/ ACW/ Raw Water etc.

### 27.3.00 Material

- 27.3.1 Alternate materials offered by Bidder against those specified shall either be equal to or superior to those specified, the responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.
- 27.3.2 No extra credit would be given to offers containing materials superior to those specified. Likewise no extra credit would be given to offers containing pipe thickness more than specified.
- 27.3.3 All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockiest are not acceptable.
- 27.3.4 All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable reference to enable identification of the certificate that certifies the material.
- 27.3.5 Material of construction for pipes carrying various fluids shall be as follows:

|   |                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                        |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Intake Water, Raw water, Ash water, Circulating Water (CW), Aux. Cooling water (ACW), clarified Water, CW blow down, *Effluent disposal, service water, AHP Seal Water, Air Pre-Heater Wash water, Passivated DM Water and clarifier sludge. | IS-2062 Gr. B/ASTM-A-36/ASTM A-53 type 'E' Gr. B/IS-3589 Gr. 410/IS-1239 Heavy. Buried CW pipes shall be encased in 500 mm thk RCC. At road crossings live loads should be considered and this encasing thickness shall vary accordingly. 150 NB & above pipes shall be spiral welded. |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|    |                                                                                                                          |                                                                                                                                                               |
|----|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2  | Dematerialized water, (condenser Make up water, Boiler fill and Deaerator Fill water) & DMCW overhead tank make-up water | Stainless steel to ASTM A-312, Gr. 304 welded for sizes above 50mm NB<br><br>Stainless steel to ASTM A312, Gr. 304 sch. 40 Seamless for sizes 50 mm and below |
| 3. | *Drinking (potable) water                                                                                                | ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to IS-4736 or equivalent.                                               |
| 4. | Instrument air & plant air.                                                                                              | ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to IS-4736 or equivalent.                                               |
| 5. | Fuel Oil piping                                                                                                          | API5L                                                                                                                                                         |

**NOTE:** Bidder to note that for Effluent disposal system and potable water system for colony (\* marked) Ductile Iron (DI) pipes conforming to IS 8329 and for fittings IS 9523 can be offered as an alternate to the mild steel/ galvanized mild steel pipes as specified above for standalone or outside plant boundary stretches. Various design aspects of DI piping has been discussed later in Annexure-I.

- 27.3.6 In water lines, pipes upto 150 mm NB shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr. B/IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS: 1239 Grade heavy except for demineralised water, drinking water and condensate spill lines.
- 27.3.7 Pipes of above 150 mm NB shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr. 410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr. B/ASTM-A-36. However, larger pipes, i.e. 1000 mm NB and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr. B and shall meet the requirements of AWWA-M-11(for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/ surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).
- 27.3.8 In demineralised water service, the pipes upto 50 NB shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65 mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness.
- Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.
- 27.3.9 Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410/IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent

internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B/IS: 3589, Gr. 410/IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).

- 27.3.10 Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.
- 27.3.11 Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.
- 27.3.12 If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.
- 27.3.13 Buried CW Pipes/ headers shall be minimum 12 mm thick, encased in 500 mm thk RCC. However this thickness shall be reviewed for live loads at road crossings according to AWWA M11 and increased adequately, if required.

#### 27.4.0 Piping Wall Thickness

- 27.4.1 The calculation of wall thickness required for pipelines subject to internal and/or external pressure shall be based on the formulae and recommendations as given in the applicable codes. Adequate allowances shall be made towards thinning due to bending, weakening at branch connections, threading, commercial tolerances on pipe wall thickness, corrosion and erosion, etc., and the same shall be subject to approval by Purchaser. In any case a minimum corrosion allowance of 1.6 mm shall be considered while selecting the thickness.
- 27.4.2 In case of carbon steel materials, the nominal wall thickness of pipeline shall not be less than the minimum acceptable values given below:

| NB mm<br>(inch)    | 15<br>(1/2) | 30<br>(3/4) | 25<br>(1)   | 32<br>(1¼)  | 40<br>(1.5) | 50<br>(2)   | 65<br>(2.5) | 80<br>(3)   | 100<br>(4) | 125<br>(5) |
|--------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|------------|
| Min. thickness, mm | 3.2         | 3.2         | 3.6         | 3.6         | 3.6         | 3.6         | 3.6         | 4.0         | 4.5        | 5.4        |
| NB mm<br>(inch)    | 150<br>(6)  | 200<br>(8)  | 250<br>(10) | 300<br>(12) | 350<br>(14) | 400<br>(16) | 450<br>(18) | 500<br>(20) | 600 (24)   |            |
| Min. thickness, mm | 5.4         | 6.35        | 6.35        | 6.35        | 7.1         | 7.1         | 7.1         | 8.0         | 8.0        |            |

- > NB 600 mm to NB 900 mm - 8.0 mm
- > NB 900 mm to NB 1200 mm - 10.0 mm
- > NB 1200 mm to 1400 mm - 12.0 mm
- > NB 1400 mm to 1600 mm - 14.0 mm
- > NB 1600 mm to NB 2200 mm - 16.0 mm
- > NB 2200 mm - 18.0 mm

**NOTE:** For buried CW pipe with 500 mm thick RCC encasing (as detailed in cl. no. 27.3.5), the minimum acceptable thickness shall be as indicated below.

|                           |   |         |
|---------------------------|---|---------|
| > NB 600 mm to NB 900 mm  | - | 8.0 mm  |
| > NB 900 mm to NB 1200 mm | - | 10.0 mm |
| > NB 1200 mm              | - | 12.0 mm |

**27.5.00 Piping Layout**

- 27.5.1 Piping shall be grouped together where practicable and routed to present a neat appearance.
- 27.5.2 Piping routing shall be such as to provide sufficient clearance for removal and maintenance of equipment, easy access to valves, instruments and other accessories. The piping shall not encroach on the withdrawal space of various equipments.
- 27.5.3 Over head piping shall have a normal minimum vertical clearance of 2.5 meters above walkways and working areas and 8 m above roadways/railways. When several pipelines are laid parallel, flanged joints must be staggered. Welded and flanged joints should as far as possible be located at one third span from supports. If the support is situated right under the welded joints this joint must be reinforced with a strap. Flanged and welded joints must be avoided in the middle of the span. Valves should be located in such a manner so as to ensure their convenient operation from the floor or the nearest platform.
- 27.5.4 Pipelines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipe and submit to Employer for approval.
- 27.5.5 All piping shall be routed so as to avoid interference with other pipes and their hangers and supports, electrical cable trays, ventilation ducting, structural members, equipment etc.
- 27.5.6 Adequate clearance shall be ensured with respect to the above to accommodate insulation and pipe movements, if any.
- 27.5.7 Piping shall generally be routed above ground but where specifically indicated / approved by the project Manager the pipes may be arranged in trenches or buried. Pipes at working temperature above the ambient shall however not be buried.
- 27.5.8 Sufficient up stream and down stream lengths shall be provided for flow measuring devices, control valves and other specialties.
- 27.5.9 All local instruments shall be located on pipelines as to render them observable from the nearest available platforms.
- 27.5.10 Openings provided in the wall for pipelines must be closed with bricks and mortar with 10-12 mm clearance between brick work and pipe after taking care of insulation and thermal movement, if any. The clear space must be filled with felt or asbestos or approved filling compound.

**27.6.00 Slope / Drains and Vents**

27.6.1 Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent shall not be less than 15 mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15 mm for line size up to 150 mm, not less than 20 mm up to 300 mm and not less than 25 mm for 350 mm to 600 mm pipes and not less than 50 mm for 600 mm and above pipes.

27.6.2 Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.

**27.7.0 Pipe Joints**

In general all water lines 65 mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50 mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.

**27.7.1 Screwed Joints**

- (a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/IS:554 unless specified otherwise.
- (b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be joined by welding. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, alongwith the nascent threaded metal portion at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test.

- (c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately.
- (d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. Any site welding done on galvanized pipes shall be done with zinc-rich special electrodes and the welded surfaces whether inside or outside shall be coated with zinc-silicate pasts. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydro testing.
- (e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.

**27.7.2 Welded Joints**

- (a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.

**27.7.3 Flanged Joints**

- (a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only.
- (b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification.
- (c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.

**27.8.00 Bends / elbows / mitre bends / Tees / Reducers & other fittings**

27.8.1 Unless otherwise specified elbows shall be of long radius type.



- 27.8.2 For pipe sizes up to 65 Nb, long radius forged elbows or seamless pipe bends shall be used. Pipe bends, if used, shall be cold bent to a radius measured to the centre line of pipe of 3 to 5 times the pipe diameter.
- 27.8.3 For steel pipes 80 Nb and above, seamless long radius forged elbows shall be used. For pipe size 250 Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. Bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.
- 27.8.4 Mitre bends are not acceptable in case of rubber lined mild steel pipes.
- 27.8.5 For pipe fittings such as reducers and tees, the material shall be to ASTM-A-234 gr. WPB up to 300 NB. For pipe reducers and tees above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fittings shall conform to the dimensional standard of ANSI B-16.9.
- However, for pipes upto 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.
- For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.
- 27.8.6 Stainless steel fittings shall conform to either ASTM-A-182, Gr. 304 (316 for Sea water application, if any) or ASTM-A-403, Gr. WP 304 (316 for Sea Water application, if any) Class-S, for sizes upto and including 50 mm NB, i.e. the fitting shall be of seamless construction.
- However, for stainless steel fittings above 50mm NB, the same shall conform to ASTM-A-403, Gr. WP 304 (316 for Sea water application, if any), Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.
- 27.8.7 In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.
- 27.9.00 Flanges**
- 27.9.1 Flanges shall be slip on type. Welding of flanges in tension is not permitted.
- 27.9.2 All flanges and flanged drilling shall be to ANSI B 16.5/BS EN-1092 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 (316 for Sea water application, if any) or equivalent.

**27.10.00 Specific technical requirement of laying buried pipe with anti corrosive treatment**

The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.

**27.10.1 Trenching**

- (a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822 or any international standard.
- (b) Free access shall be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side so that good welded joint is obtained.
- (c) The free working space shall conform to IS: 5822. The trench shall be excavated so as to provide minimum cover of 1000 mm between the top of the pipe and finished grade.
- (d) Prior to lowering and laying pipe in any trench, the bidder shall backfill and compact the bottom of the trench or excavation in accordance with IS: 5822 to provide an acceptable bed for placing the pipe.
- (e) Coating and Wrapping shall be done as under.

**27.10.2 Preparation and cleaning of piping**

- (a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Kerosene will not be permitted for cleaning. This cleaning operation shall be immediately followed by priming with the mechanical priming machine.
- (b) Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.
- (c) On the internal surface for pipes 1000 NB and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.
- (d) The cleaning and priming operation shall be carried out at site. The entire pipe length shall be cleaned but the ends of the pipes shall be left without coating for a distance of 230 mm for joints, which shall be coating manually at site after laying, welding and testing the pipe.

**27.10.3 Coating and wrapping / Anti corrosive Protection Coal tar tape**

- a. Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are:

- (1) Coating primer (coal tar primer)
- (2) Coating enamel (coal tar enamel)
- (3) Wrapping materials.

All primer/coating/wrapping materials and methods of application shall conform to IS: 10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable.

Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat.

Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of Coats and wraps shall be decided based on soil corrosivity/resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available.

Total thickness of completed coating and wrapping shall not be less than 4.0 mm.

- b. Alternatively, the anti-corrosive protection for buried pipes can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal tar primer in steps of 2 mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total thickness of the finished protective coating shall be 4.0 mm min.

**27.10.4 Trench bed preparation and back filling**

Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.

**27.10.5 Laying of galvanized steel (GI) pipes**

All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. Threaded portion on either side of the socket joints shall be applied with Zinc silicate paste.

All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and "anti corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also.

**27.11.00 Cleaning and Flushing**

- 27.11.1 All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.
- 27.11.2 Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done in such a manner that the coating on MS pipe is not affected.
- 27.11.3 After erection, all water lines shall be hydro tested at 1.5 times the design pressure.
- 27.11.4 All compressed air pipe work shall be cleaned by blowing compressed air.

**27.12.00 Painting of Pipes****27.12.1 Buried Piping****Internal surfaces**

- (i) Surface cleaning by sand blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

**External surfaces**

- (i) Surface cleaning by Sand Blasting.
- (ii) Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.
- (iii) Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982.

The total thickness of the coating will not be less than 4.0 mm

- (iv) Alternatively Wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm.

NOTE : CW piping shall be encased in 500 mm thk RCC.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

### 27.12.2 Overground Piping

#### Internal surfaces

- (i) Surface cleaning by sand blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 140 microns (min).

#### External surfaces

- (i) Surface cleaning by Sand Blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 140 microns (min).

### 27.12.3 Other requirements

- (a) Paint manufacturers instructions shall be followed in method of application, handling, drying time etc.
- (b) The color of the finish paint shall be as per approved color-coding.
- (c) If finish paint was applied in shop, one coat of finish paint shall be applied at site.
- (d) The dry film thickness of paint shall not be less than 0.15 mm.

### 27.12.4 Color code for identification

The pipes shall be color painted/banded for identification as per the approved color-coding scheme and shall be generally as per IS-9404.

### 27.13.00 Specification for hangers and supports

27.13.1 All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.

27.13.2 While designing supports for rubber lined pipes special consideration should be given. Any kind of welding on these pipes is not allowed after rubber lining.

- 27.13.3 Hanger for piping 65 mm Nb and larger and all spring support assemblies regardless of size shall be completely engineered in conformance with the provisions of power piping code ANSI B 31.1.
- 27.13.4 Hangers, saddles, supports etc. shall be fabricated from plates/pipes sections conforming to ASTM A 53/IS: 2062/IS:226/ or equivalent. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. The structural steel work shall be as per IS: 800/BS:4360. Insulation protection saddles shall be used at support point of all insulated piping.
- 27.13.5 The support shall be so interspaced as to minimize sagging of the pipes and to keep them within permissible limits where pipes are full with the conveying media.
- 27.13.6 The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.
- 27.13.7 All pipe supports shall be designed to provide an absolute minimum head room of 2.5 m from floor in passages/walkways.
- 27.13.8 At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.
- 27.13.9 All components of hangers/support shall be provided with two coats of primer (red oxide paint) at shop before dispatch to site. After erection they shall be given finish coat of Long Oil Synthetic enamel to IS: 2932 of total DFT 100 to 140 microns. CLH & VLH will be primed with Epoxy Zinc rich primer of 50 micron followed by finish painting of Aliphatic Acrylic Polyurethane or equivalent of DFT 65 microns.
- 27.14.00 Design / Construction / Material Particulars of Gate / Globe / Check Valves / Globe Stop Valve / Butterfly Valve**
- 27.14.1 GENERAL**
- (a) All valves shall be suitable for the service conditions i.e. flow, temperature and pressure, at which they are required to operate.
- (b) General requirement of valves are as indicated below:
- (1) The valves as well as all accessories shall be designed for easy disassembly and maintenance.
  - (2) Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion.
  - (3) All rising stem valves shall be provided with back seat to permit repacking (of glands) with valves in operation. All valves shall preferably be of outside screw and yoke type.
  - (4) All valves shall be closed by rotating the hand wheel in the clockwise direction when looking at the face of the hand wheel. In case where the hand wheel is not directly attached to the valve spindle suitable gearing shall be introduced.

- (5) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.
  - (6) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required. For valves of size 350 mm and above either bevel or spur gearing shall be provided to facilitate manual operation.
  - (7) The valves coming in vacuum lines shall be of extended gland type and / or water sealed.
- (c) The actuator-operated valves shall be designed on the basis of the following:
- (1) The internal parts shall be suitable to support the pressure caused by the actuators.
  - (2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.
  - (3) All actuator-operated valves shall be provided with hand operated gearing mechanism also.
  - (4) All actuators operated valves shall open/close fully within time required by the process.
- (d) Valves coming under the purview of IBR shall meet IBR requirements.
- (e) Gate/sluice valves shall be used for isolation of flow. Gate valves shall be provided with the following accessories in addition to other standard items:
- (1) Hand wheel
  - (2) Position indicator (for above 50 mm NB valve size)
  - (3) Draining arrangement wherever required.
- (f) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction.
- (g) Check valves shall be used for non-return service. They shall be swing check type or double door (Dual plate) check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring controlled opening/closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600 mm NB.
- (h) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing.

- (i) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.
- (j) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.
- (k) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer.
- (l) All valves except those with rising stems shall be provided with continuous mechanical position indicator; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.
- (m) For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS-1538 for fitting shall be applicable.

**27.14.2 VALVE BODY MATERIAL**

Valve body material for various services shall be as follows:

Valve body material for water application like circulating water, Secondary circuit auxiliary cooling water of ECW system, Raw water, Ash water make-up, service water, clarified water, DM cooling water (pH corrected) & drinking water shall be cast iron for sizes 65 NB and above; gun-metal for sizes 50 Nb and below.

For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.

DM water: SS body and disc alongwith SS internals.

Condensate: Cast Carbon Steel/Forged Carbon Steel.

- 27.14.2.1 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes and the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.

**Standards and Codes**

AWWA-C-504

Rubber seated butterfly valves



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|                |                                                                              |
|----------------|------------------------------------------------------------------------------|
| BS-5155/EN-593 | Cast iron and steel body butterfly valves for general purpose.               |
| IS-778         | Gun-metal gate, globe and check valves for general purpose.                  |
| BS-5154        | Copper alloy globe/globe stop and check and gate valves for general purpose. |
| IS-780         | Sluice valves for water works purpose (50-300 mm size)                       |
| IS-2906        | Sluice valves for water works purpose (350-1200 mm size)                     |
| IS-5150        | Cast iron wedge and double disc gate for general purpose.                    |
| BS-5152        | Specification for cast iron globe valves                                     |
| BS-5153        | Cast iron check valves for general purpose.                                  |
| IS-5312        | Swing check type reflux (non-return) valves                                  |
| ANSI B 16.34   | Standard for valves                                                          |
| API-594        | Standard for Dual-check valves                                               |
| API-600        | Steel gate valves                                                            |
| ANSI-B-16.10   | Valves face to face and other relevant dimension                             |
| API-598        | Valves inspection test                                                       |

**27.14.2.2 End Connections**

The end connections, shall comply with the following:

Socket welding (SW) – ANSI B 16.11

Butt Welding (BW) – ANSI B 16.25

Threaded (SC) – ANSI B 2.1

Flanged (FL) – ANSI B 16.5 & AWWA-C-207 (steel flanges), ANSI B 16.1 (Cast Iron flanges)

27.14.2.3 All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).

27.14.2.4 All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.

- 27.14.2.5 All gun metal body valves shall have screwed ends.
- 27.14.2.6 All flanged end valves/specialties shall be furnished alongwith matching counter flanges, fasteners, gaskets etc. as required to complete the joints
- 27.15.00 Check Valves**
- 27.15.1 Check valves shall comply with the following characteristics:
- (a) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal);
  - (b) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position.
  - (c) In the case of swing check valves, the body seat shall be inclined at such an angle from the vertical as will facilitate closing and prevent chatter.
- 27.15.2 Drilling on flanges of flanged valves must correspond to the drilling on flanges of the piping system on which the valves are to be installed.
- 27.15.3 All flanged valves intended for installation in steel piping systems shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class.
- 27.15.4 Counter flanges to be installed on air pipes shall be screwed-on type irrespective of size.
- 27.16.00 Globe Valves**
- 27.16.1 The globe valves shall have the following characteristics;
- Straight conveyed flow
- Right angle
- Preferably, the valves shall be of the vertical stem type.
- 27.16.2 Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.
- 27.16.3 The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened.
- 27.16.4 For the regulating valves, valves with regulating plug & parabolic outline disc type is preferred.

27.16.5 All motorized globe valves with regulating plug for which indication of percentage (%) opening are required in the control room shall be provided with necessary position transmitter.

#### 27.17.00 Gate valves

All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate.

Gate valves shall be of the solid/elastic or articulated wedge disc and rising stem type.

#### 27.18.00 Air Release Valve

- (a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.
- (b) The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure.
- (c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS:210 Gr. FG 260 and spindle shall conform to high tensile brass.
- (d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/butterfly valve.

125# ASA cast iron body, double ball construction air release valve with flanged ends to ASA B 16.10; and bolted cover to release the air. Construction materials shall be as below:

|               |   |                                   |
|---------------|---|-----------------------------------|
| Body, cover   | : | Cast iron to IS:210 Gr.FG 260     |
| Bolts         | : | Light weight leather/wooden balls |
| Seats         | : | Bronze to ASTM-B-62               |
| Cover packing | : | Braided asbestos                  |
| Float         | : | Wood/rubber                       |

**27.19.00 Butterfly Valves****27.19.1 Design / Construction**

- (a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter. In such a case, however, the bidder will have to necessarily submit thickness calculations, in order to establish the integrity of the fabricated valve body under the system operating pressure condition.
- (1) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of Wafer construction are also acceptable.
  - (2) The seals, both on the body (sleeve) and on the disc shall be of the material specified. Necessary shaft seal shall be provided and adequately designed to ensure no leakage across the seal. This seal shall be designed so that they will allow replacement without removal of the valve shaft. The sealing ring on the disk shall be continuous type and easily replaceable.
  - (3) For all types of valves, the design with shaft eccentric to the disc is preferred. The shaft shall be solid type and shall pivot on bushings. Bushings/sleeve type bearings shall be contained in the hub of valve body. The bearing shall be self-lubricated type with low coefficient of friction and should not have any harmful effect on water and on valve components.
  - (4) The design of the shaft shall be such that it will safely sustain maximum differential pressure across the closed valve. The shaft and any key (taper pin etc.) for transmitting the torque between shaft and disc shall be capable of withstanding the maximum torque required to operate the valve. However, the shaft diameter shall not be less than the minimum shaft diameter specified in relevant code. Necessary Torque Calculation and the torque class selected on the basis of the same shall be furnished to the Employer for information.
  - (5) The disc shall rotate from the full open to the tight shut position. The disc shall be contoured to ensure the least possible resistance to flow and shall be suitable for throttling operation. While the disc is in the throttled position, valve shall not create any noise or vibration.
  - (6) The operating mechanism shall be mounted directly on or supported from the valve body.
  - (7) All valves shall be complete with:
    - Position indicator (located in a visible place)
    - Arrow indicating the flow direction;

Adjustable mechanical stop limiting devices to prevent over

Travel of valve disc in open/close position.

All valves shall be "tight shut off"

(8) Hand operated valves shall have the following

Local hand controls

The hand controls shall close the valve with clockwise rotation.

The hand controls shall be dimensioned to guarantee an easy maneuver under most severe conditions.

The hand controls shall be provided with locking systems suitable to avoid the disc assuming a non-desirable position during the operation.

Hand wheel shall be made of malleable iron with arms and rims of adequate strength. The hand wheel of diameters 300 mm or less shall be provided with handles for ease of operation. The pulling force required on the hand wheel rim shall not exceed 25 Kgf when operating the valve under full flow and operating pressure.

Valves-350 Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.

Valves-350 Nb and above shall also be provided with gear operator arrangement suitable for manual operation. Manual operation of valve shall be through worm and gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque. It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction.

Limit and torque switches (if applicable) shall be enclosed in water tight enclosures alongwith suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.

27.19.2 Material of Construction (Butterfly Valves)

Materials and other design details shall be as indicated below:

(a) Cast Iron Butterfly valves

|             |                                                                                     |
|-------------|-------------------------------------------------------------------------------------|
| Body & Disc | ASTM A48, Gr. 40 with 2% Ni/<br>IS: 210. Gr. FG-260, with 2%<br>Ni and epoxy coated |
|-------------|-------------------------------------------------------------------------------------|

|       |                                                                                                                     |
|-------|---------------------------------------------------------------------------------------------------------------------|
| Shaft | BS 970 431 S: 291/EN 57, or<br>AISI-410 or AWWA-permitted shaft material<br>equivalent to EN-57/AISI-410 or better. |
|-------|---------------------------------------------------------------------------------------------------------------------|

|                   |                                        |
|-------------------|----------------------------------------|
| Seat ring<br>Seal | 18-8 Stainless steel<br>Nitrile Rubber |
|-------------------|----------------------------------------|

## (b) Stainless Steel Butterfly Valves

|             |                                         |
|-------------|-----------------------------------------|
| Body & Disc | ASTM A 351, Gr. CF8M/ASTM-A-182-Gr. 304 |
|-------------|-----------------------------------------|

|       |                                                      |
|-------|------------------------------------------------------|
| Shaft | ASTM A 182, Gr. 316/ASTM-A-479 Gr.<br>316/Equivalent |
|-------|------------------------------------------------------|

|                   |                     |
|-------------------|---------------------|
| Disc & Seat Rings | EPT/BUNA-N/Neoprene |
|-------------------|---------------------|

## (c) Carbon Steel Butterfly Valves

|                      |                                                                             |
|----------------------|-----------------------------------------------------------------------------|
| Body & Disc<br>Shaft | ASTM A 216, Gr. WCB<br>ASTM A 182, Gr. 304/ASTM-A-479 Gr.<br>304/Equivalent |
|----------------------|-----------------------------------------------------------------------------|

|                   |                     |
|-------------------|---------------------|
| Disc & Seat Rings | EPT/BUNA-N/Neoprene |
|-------------------|---------------------|

## 27.19.3 Proof of Design Test (Type Test) for Butterfly Valves

Proof of Design (POD) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual POD test shall be conducted by the bidder in the presence of Employer's representative.

All valves that are designed and manufactured as per AWWA-C-504 shall be governed by the relevant clauses of POD test in AWWA-C-504. For Butterfly valves designed and manufactured to EN-593 or equivalent, the POD test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of POD test of AWWA-C-504.

## 27.20.00 MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)

(a) The materials shall generally comply with the following:

## (1) Cast Steel Valves

|                               |                                   |
|-------------------------------|-----------------------------------|
| Body & bonnet                 | ASTM A 216 Gr. WCB/<br>ASTM A 105 |
| Disc for non-return<br>Valves | ASTM A 216 Gr. WCB/<br>ASTM A 105 |
| Trim.                         | ASTM A 182 Gr. F6 or Equivalent   |

## (2) Stainless Steel Valves

|               |                       |
|---------------|-----------------------|
| Body & Bonnet | ASTM A 351 Gr. CF 8M/ |
|---------------|-----------------------|



ASTM A 182 Gr. 304

Disc -do-

Trim. ASTM 182 Gr. F. 316  
/ASTM-A-479 Gr. 316 or Integral  
with body**(3) Cast Iron Valves**

Body &amp; bonnet BS 1452 Gr. 14/IS-210 Gr. FG 260

Seating surfaces and rings 13% chromium steel/13% Chrome  
overlay

Disc for non-return valves BS 1452 Gr. 14/IS-210 Gr FG 260

Hinge pin for non-return valves AISI 316

Stem for gate globe valves 13% chromium steel or Equivalent

Back Seat 13% chromium steel / 13%  
Chrome overlay**(4) Gun Metal Valves**

Body and bonnet IS 318 Gr. 2/Equivalent Standard

Trim -do-

- (b) Cast iron body valves shall have high alloy steel stem and seat.
- (c) Material for counter flanges shall be the same as for the piping.

**27.21.00 Float Operated Valves**

- (a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.
- (b) **DESIGN AND CONSTRUCTION FEATURES**  
The following design and construction feature of the valve shall be the minimum acceptable.
- (c) Valves shall be right-angled or globe pattern.
- (d) Valves shall be balance piston type with float ball.
- (e) Leather liner shall not be provided.
- (f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or Is: 210 Grade 200 or equivalent, and float shall be of copper with epoxy painting of two (2) coats.
- (g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec.
- (h) The valves shall have flanged connections.

**27.22.00 PAINTING OF VALVES:**

Two (2) coats of primer followed by three (3) coats of epoxy of approved color code/shade (usually same as that of connected piping) shall be applied to all exposed surfaces except stainless steel surface, Galvanized steel surface and gun metal surface at shop as required to prevent corrosion, before dispatch. The use of grease/oil other than light grade mineral oil, for corrosion protection is prohibited. The total DFT of painting shall be 150 micron (minimum). If during transport, unloading/unpacking or erection at site any part of the painted surface gets damaged, the same shall be made good by the contractor by repainting with compatible painting primer and enamel to the satisfaction of the project manager.

**27.23.00 RUBBER EXPANSION JOINTS**

- 27.23.1 All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition.
- 27.23.2 The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.
- 27.23.3 The tube (i.e. inner cover) and the cover (outer) shall be made of natural or synthetic rubber of adequate hardness. The shore hardness shall not be less than 60 deg. A for outer and 50 deg. A for inner cover.
- 27.23.4 The carcass between the tube and the cover shall be made of high quality cotton duck, preferably, square woven to provide equal strength in both directions of the weave. The fabric plies shall be impregnated with age resistant rubber or synthetic compound and laminated into a unit.
- 27.23.5 Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.
- 27.23.6 Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipelines.
- 27.23.7 The expansion joints shall be of heavy duty construction made of high grade abrasion-resistant natural or synthetic rubber compound. The basic fabric for the 'duck' shall be either a superior quality braided cotton or synthetic fibre having maximum flexibility and non-set characteristic.
- 27.23.8 The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.
- 27.23.9 All expansion joints shall be provided with stainless steel retaining rings for DM water application and IS 2062 Gr. B galvanized steel retaining rings for ordinary water for use on the inner face of the rubber flanges, to prevent any possibility of damage to the rubber when the bolts are tightened. These rings shall be split and beveled type for easy installation and replacement and shall be drilled to match the drilling on the end rubber flanges and shall be in two or more pieces.

- 27.23.10 The expansion joints shall have integral fabric reinforced full-face rubber flanges. The bolt on one flange shall have no eccentricity in relation to the corresponding bolt hole on the flange on the other face. The end rubber flanges shall be drilled to suit the companion pipe flanges.
- 27.23.11 All exposed surfaces of the expansion joint shall be given a 3 mm thick coating of neoprene. This surface shall be reasonably uniform and free from any blisters, porosity and other surface defects.
- 27.23.12 Each control unit shall consist of two (2) numbers of triangular stretcher bolt plates, a stretcher bolt with washers, nuts, and lock nuts. Each plate shall be drilled with three holes, two for fixing the plate on to the companion steel flange and the third for fixing the stretcher bolt.
- 27.23.13 Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.
- 27.23.14 Bidder to note that any metallic part which comes in contact with DM / Corrosive water shall be of stainless steel material.

**27.24.00 STRAINERS****27.24.1 Simplex type**

The strainers shall be basket type and of simplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. The strainer element shall be 20 mesh. Pressure drop across the strainers in new condition fitted with a removable plug. The material of construction of various parts shall be as follows:

- |     |                  |                                                                                                                     |
|-----|------------------|---------------------------------------------------------------------------------------------------------------------|
| (a) | Body             | IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent) |
| (b) | Strainer Element | Stainless steel (AISI 316)                                                                                          |
| (c) | End connection   | Screwed upto 50 mm Nb, and flanged above 50 mm Nb                                                                   |

**27.24.2 Duplex type**

- (a) The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow.
- (b) Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.

- |      |                                               |
|------|-----------------------------------------------|
| Body | IS: 318, Gr. 2<br>Up to 50 mm Nb, and IS:210, |
|------|-----------------------------------------------|

Gr. FG 260 of ASTM-A-515 Gr. 75/IS-2062  
Gr. B and internally epoxy-painted above 50 mm NB.

Strainer element      Stainless steel (AISI 316)

End connection      Screwed up to 50 mm Nb, and  
Flanged above 50 mm Nb.  
Gasket shall be of full face type

- (c) The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data.
- (d) The size of the strainer and the flow direction will be indicated on the strainer body casting.
- (e) Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.

27.24.3 Three shop coats of paint preceded by two coats of primer shall be applied to all exposed surfaces as required to prevent corrosion. All parts shall be adequately protected for rust prevention. The use of grease or oil other than light grade mineral oils for corrosion protection is prohibited

**ANNEXURE-I****SPECIFICATION FOR DUCTILE IRON (DI) PIPES, FITTINGS & SPECIALS****1.00.00 GENERAL**

This specification covers the specific requirement of design, material, manufacture / fabrication, constructional features, inspection & testing, transportation, handling, laying, site testing and annual maintenance contract of Ductile Iron (DI) Pipes, Joints, fittings and specials.

**2.00.00 CODES AND STANDARDS**

The material, design, manufacture, dimensions, tolerances, mechanical properties, internal cement mortar lining, external zinc coating along with bituminous finished layer, inspection and testing of DI water pipes shall comply with the latest Indian Standard, "IS 8329 (Centrifugally cast (spun) ductile iron pressure pipes for water, gas and sewage – specification)" or equivalent international standard unless otherwise specified elsewhere in this Technical Specification.

| Sl. No. | Code No. | Code Title                                                                                                 |
|---------|----------|------------------------------------------------------------------------------------------------------------|
| 1       | IS 8329  | Centrifugally cast (spun) ductile iron pressure for water, gas and sewage - specification                  |
| 2       | IS 9523  | Ductile iron fittings for pressure pipes for water, gas and sewage - specification                         |
| 3       | IS 5382  | Rubber sealing rings for gas mains, water mains and sewers                                                 |
| 4       | IS 638   | Specification for Sheet Rubber Jointing and Rubber Insertion Jointing                                      |
| 5       | IS 12288 | Code of practice for use and laying of Ductile Iron pipes                                                  |
| 6       | IS 11606 | Methods of sampling of Cast Iron pipes and fittings                                                        |
| 7       | IS 455   | Portland slag cement                                                                                       |
| 8       | IS 12330 | Sulphate resisting Portland cement                                                                         |
| 9       | IS 6452  | Specification for high alumina cement for structural use                                                   |
| 10      | IS 6909  | Specification for supersulphated cement                                                                    |
| 11      | IS 8112  | 43 grade ordinary Portland cement                                                                          |
| 12      | IS 1387  | General requirements for supply of metallurgical materials                                                 |
| 13      | IS 1500  | Methods for Brinell hardness test for metallic materials                                                   |
| 14      | IS 1608  | Mechanical testing of metals – tensile testing                                                             |
| 15      | ISO 2531 | Ductile iron pipes, fittings, accessories and their joints for water applications                          |
| 16      | ISO 4179 | Ductile iron pipes and fittings for pressure and non-pressure pipelines – Cement mortar lining             |
| 17      | ISO 4633 | Rubber seals – Joint rings for water supply, drainage and sewerage pipelines – Specification for materials |

|    |           |                                                                                                                          |
|----|-----------|--------------------------------------------------------------------------------------------------------------------------|
| 18 | ISO 8179  | Ductile iron pipes – External zinc-based coating – Part 1: Metallic zinc with finishing layer                            |
| 19 | ISO 8179  | Ductile iron pipes – External zinc coating – Part 2: Zinc rich paint with finishing layer                                |
| 20 | ISO 8180  | Ductile iron pipelines – Polyethylene sleeving for site application                                                      |
| 21 | ISO 10802 | Ductile iron pipelines – Hydrostatic testing after installation                                                          |
| 22 | ISO 10803 | Design method for ductile iron pipes                                                                                     |
| 23 | ISO 16132 | Ductile iron pipe and fittings – seal coats for cement mortar linings                                                    |
| 24 | AWWA M 41 | Ductile iron pipe and fittings (guideline code for design, manufacturing, testing, jointing, laying & installation etc.) |
| 25 | BS EN 545 | Ductile iron pipes, fittings, accessories and their joints for water pipelines – Requirements and test methods           |

### 3.00.0 DUCTILE IRON (DI) PRESSURE PIPES:

#### 3.01.01 DESIGN REQUIREMENTS

Pipeline shall be sized considering C value as 140 and velocity 2-3m/sec.

#### 3.01.01 Classification:

The class of DI pipes to be provided shall be as specified in the data sheet attached with this sub-section. The external diameter and wall thickness of socket and spigot pipes for the specified Class shall be as per IS 8329 or equivalent international standard.

#### 3.02.00 Joints:

3.02.01 Generally push-on flexible joints shall be provided for pipe to pipe connection as per IS 8329 or equivalent international standard. However mechanical joints, flange joints and restrained joints can also be used.

#### 3.02.02 Rubber gaskets

Rubber gasket used with push-on flexible joints shall conform to the requirements of IS: 5382 or equivalent international standard. Rubber gaskets for use with flanged joints shall conform to IS 638 or approved equivalent international standard.

### 4.00.00 DI FITTINGS & SPECIALS

#### 4.01.0 Design Requirements

#### 4.01.01 Classification

The DI fittings shall be as per IS 9523 or equivalent international standard.

## 4.02.00 External layer:

The DI fittings supplied shall be provided with external protection of metallic zinc coating or zinc rich paint coating with finishing layer of bituminous paint as per IS 9523 or equivalent international standard.

## 4.03.00 Internal lining:

The fittings shall be provided with suitable cement mortar internal lining as per IS 9523 or equivalent international standard.

## 4.04.00 Joints between pipe and fittings:

## 4.04.01 Generally , Push-on flexible joints shall be provided for pipe to fitting connection as per IS 9523 or equivalent international standard. Flange joints, wherever required, shall conform to the requirements of IS 9523 or equivalent international standard.

## 4.04.02 Rubber gaskets

All the DI fittings shall be provided with rubber gaskets for each socket. Rubber gasket used with push-on flexible joints shall conform to the requirements of IS: 5382/ IS 9523 or equivalent international standard.

Rubber gaskets for use with flanged joints shall conform to IS 638 or equivalent international standard.

## 5.00.00 TYPE TESTS

## 5.01.00 The contractor / manufacturer shall carry out the type tests as listed in this specification on the pipes to be supplied under this contract.

## 5.02.00 The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

## 5.03.00 In case the contractor / manufacturer has already conducted such specified type test(s), he may submit the type test reports to the Employer during detailed engineering for consideration of waiver of conductance of such type test(s) or otherwise as deemed fit by Employer. Such test(s) should have been either conducted at an independent laboratory or duly approved by accredited third party agency. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract.

## 5.04.00 The type test shall be performed whenever a significant change is made in the design, material or process of manufacture or a new size or size range of the product is being supplied by the manufacturer.

**5.05.00 THE FOLLOWING TYPE TESTS SHALL BE CARRIED OUT:****5.05.01 Joint Leak Tightness Test:**

- a) Tests for joints (push-on flexible joints) shall be conducted as per the guidelines of ISO 2531 to establish adequate joint performance with respect to internal pressure, external pressure and vacuum pressure under both normal alignment of joints and deflected alignment of joints as dictated in ISO 2531.
- b) Tests for Leak tightness and mechanical resistance of flanged joints shall be conducted as per ISO 2531.

**5.05.02 Cement Lining Smoothness Type Test:**

The contractor / manufacturer should have carried out Cement Lining Smoothness test to establish C value (Hazen & William's constant) of the offered DI pipe as 140. Necessary certificate for the same shall be furnished to the employer.

In case the contractor / manufacturer has not carried out the test, the same shall be carried out by the contractor / manufacturer within the scope of this contract.

**5.05.03 Ring bend test:**

Ring bend test for 3% deflection with respect to external diameter of DI pipe offered shall be conducted by contractor / manufacturer to prove that internal cement mortar lining does not come off the substrate surface of Ductile Iron on random basis for each manufacturing lot.

If the contractor / manufacturer of pipes do not have the facility for this type test at his own works, the same can be arranged by him to conduct and demonstrate the test.

**6.00.00 LAYING AND JOINTING OF DI PIPES:****6.01.00 Laying, erection and jointing of DI pipelines at field / site shall be under the direct supervision of Manufacturer (Supplier) from whom pipe is sourced / procured.**

For underground laying, Special provisions in trench shall be made for accommodating socket (Bell) of each pipe, as applicable so that barrel is uniformly rested on even trench bed surface, which is well compacted as recommended in codes / standards.

**6.02.00 Pipeline anchorage**

Pipeline shall be securely anchored at dead ends, tees, bends, tapers and valves to resist thrust arising from internal pressure. Suitable thrust blocks made of concrete shall be designed and cast-in-situ.

**7.00.00HYDRAULIC TESTING OF PIPELINES**

After laying and jointing, the pipeline shall be tested for soundness and leak tightness of pipes, fittings and joints, and soundness of any construction work. The pipeline may be tested in sections.

Water and other facilities as required for such hydro testing shall be arranged by the Contractor.

**7.01.00 Hydraulic Testing of Sections**

The section under test shall be filled with water, taking care that all the air is displaced either through vents at the high points or by using a pig or a sphere. After filling, the pipeline shall be slightly pressurized for a period of time to achieve stable conditions.

The pipeline is then pressurized up to the full test pressure as per the relevant standard. The test pressure shall be maintained for a period of not less than 10 minutes to reveal any defects in the pipes, joints or anchorages. The test pressure shall be measured such as to ensure that the required test pressure is not exceeded at any point in the entire pipeline.

If the test is not satisfactory, the fault shall be found and rectified. Methods employed for finding faults shall be as per IS 12288.

**7.02.00 Hydraulic Testing of Complete Pipeline**

After all the sections have been joined together on completion of section testing, a test on the complete pipeline shall be carried out. This test shall be carried out at a pressure as specified in the data sheet attached with this sub-section. During the test, the pressure at any point in the pipeline shall not exceed the pressure as specified in the data sheet attached with this subsection.

**8.00.00 DATA SHEET FOR DI PIPES, FITTINGS & SPECIALS**

| Sl.No. | Description                | Units | Parameters                                                                                                                            |
|--------|----------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Pipe Material              |       | Ductile Iron (DI) pipe internally cement mortar lined and externally coated with metallic zinc & finishing layer of bituminous paint. |
| 2      | Applicable standards       |       | IS/ISO/AWWA/BS as listed in technical specification                                                                                   |
| 3      | Hazen & William's Constant |       | 140                                                                                                                                   |
| 4      | Pipe class                 |       | K7/K9 as per IS 8329 or equivalent international standard. Compatible with system pressure requirement.                               |
| 5      | Pipe Joint type            |       | Push-on flexible joints as per IS 8329 / Flanged/ Restraint                                                                           |
|        |                            |       |                                                                                                                                       |

DCPL

**Volume III :**  
**Mechanical Works**

**Ch 27 : Low Pressure Piping,  
Valves & Specialities**  
Sheet | 33 of 33

|    |                                                   |                   |                                                                                                           |
|----|---------------------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------------|
| 6  | Pipe Joint type at valves, pumps and other piping |                   | Flange Joints as per IS 8329 & IS 9523                                                                    |
| 7  | Welded-on Flange (as applicable) pressure class   |                   | Compatible with system pressure requirement.                                                              |
| 8  | DI fittings class                                 |                   | Compatible with system pressure requirement.                                                              |
| 9  | DI fittings flange (as applicable) class          |                   | PN 25                                                                                                     |
| 10 | Restrain mechanism at bends, specials etc.        |                   | Thrust Blocks                                                                                             |
| 11 | Maximum field hydrostatic test pressure           | N/mm <sup>2</sup> | Shut-off pressure or (operating pressure+surge pressure) whichever is higher for not less than 10 minutes |
|    | At each section (not exceeding 1000m)             |                   |                                                                                                           |
|    | Complete pipeline                                 |                   | As per IS: 12288 Table-1                                                                                  |
| 12 | Other requirements                                |                   | As per technical specification                                                                            |

### **33.0 PLANT LAYOUT REQUIREMENT**

#### **33.1 Broad Guidelines for Layout Plan**

33.1.1 General layout plan indicating the available spaces for proposed project is as shown in the tender drawing. It shall form the basis for further elaboration by the Bidder for the plant facilities, which are in his scope.

33.1.2 While preparing the detailed layout, planning the facilities in the Bidder's scope and deciding upon the transportation and construction/ erection strategy and functional requirements, the Bidder shall ensure the following aspects:

- a) Face of the buildings and facilities shall be located in such a way so as to have an offset of minimum 20 m with respect to centre line of double lane road and 15 meter with respect to centre line of single lane road. The spacing between various buildings and facilities shall be suitably decided so as to avoid interference between the foundations.
- b) The entire construction activity shall take into account the commissioning of the units.
- c) The area for construction/erection facilities like lay-down, pre-assembly, offices and stores is to be managed by the Bidder within the areas available in General Layout Plan.
- d) The finished floor level at ground level of the TG building shall be designated at EL. 0.0M and shall be 500mm above the finished ground level (FGL) of that area.

The finished floor level for various areas / facilities shall be as follows:-

- |      |                                         |                                             |
|------|-----------------------------------------|---------------------------------------------|
| i)   | FFL of Main Plant Building              | - El. 0.00M                                 |
| ii)  | Top of paving for boiler / ESP area     | - EL. (-) 0.20M                             |
| iii) | Top of paving for Transformer Yard      | - El. (-) 0.10M                             |
| iv)  | FFL of Mill Bunker building and Chimney | - El. 0.00M                                 |
| v)   | FFL of offsite building                 | - 500 mm above<br>FGL of<br>respective area |
- e) Fuel storage tanks, hydrogen storage complex, etc., shall be designed in accordance with statutory agencies guideline.
  - f) Space provision shall be kept for installation of FGD in future, if required to be installed, as per MoEF requirement.
  - g) All the buildings and facilities shall be approachable by the fire tenders.



- h) Space provision shall be kept for installation of additional field of ESP.
- i) All statutory requirements including safe distances between various facilities as per applicable rules/acts/laws including local by-laws are met.

### **33.2 Control Room for Offsite facilities**

Independent Control room for each of the following off-site facilities shall be provided:

- Water system
- Makeup water system
- Ash handling system
- Coal handling system

However panels for above offsite facilities to be placed in respective CER's near respective off-site control rooms. Further Remote I/O (RIO) rooms shall be provided on as required basis for offsite areas. The exact RIO locations shall be finalised during detailed engineering stage.

Control Rooms / Control Equipment Rooms/ RIO rooms shall be air-conditioned. Batteries for power supply systems as required for RIO rooms shall be placed in a separate ventilated area within RIO rooms.

### **33.3 Main Plant Layout**

#### **Introduction**

The proposed location of main plant block is indicated in the general layout plan enclosed with the bid documents however bidder has an option to develop his own layout keeping the location/orientation of the main power block, power evacuation corridor, make-up water corridor, Ash dyke same as indicated in bid document. Bidder shall develop his own layout for the equipment offered and the same to be clearly brought out in the bid. However, while developing the layout the bidder must give due considerations for the following requirements:

- 33.3.1 The unit control room shall be located in the centre of TG building towards boiler side at operating floor level.
- 33.3.2 The unit control room shall be multi level and shall essentially house but not be limited to the followings:
  - i) Unit control panels in control equipment rooms, operator's consoles etc. for all modules. CCR shall not have any internal column inside the room. Large span roof beams for control room to be adopted and designed.
  - ii) Computer room with programmer station & associated consoles and PADO room etc.
  - iii) Electrical control panels, protection panel etc shall be suitably located.



- iv) Conference room and C&I engineer's room.
- v) Shift supervisor room.
- vi) 24V charger, UPS & batteries on unit basis in the control room below unit & common control room & control equipment room at mezzanine floor level.
- vi) Cabling and all other facilities associated with the above system.
- vii) SWAS room at 0.0M in TG building.

33.3.3 The unit control room, computer room with programmer station, PADO room, 24V charger & UPS room, SWAS room shall be located in Air conditioned areas. Washroom/Toilet facilities for ladies & gents separately shall be provided. Further, no vertical bracings, pipes, cable shafts etc. shall be routed through control room or control equipment room area.

33.3.4 The following clearances to be maintained for C&I DDCMIS cabinets:

- |      |                          |   |        |
|------|--------------------------|---|--------|
| i)   | Inter panel spacing      | - | 1200mm |
| ii)  | Clearance from back      | - | 1000mm |
| iii) | Clearance from front     | - | 1000mm |
| iv)  | Clearance from side wall | - | 1000mm |

The above clearances are minimum requirement and may increase with increase in door swing of the cabinets.

33.3.5 The cable vault space below the HT / LT switchgear room and Control Room shall have 800 mm wide and 2.1 m high movement passage all around the cable trays in the cable vault/ cable spreader room for easy laying/maintenance of cables.

33.3.6 Operating floor inside the main plant building shall match with top level of TG deck.

33.3.7 Adequate distance shall be maintained between the transformers. As basic guidelines following norms will be adhered to:

- 1) Unit and generator transformers shall be separated from the adjacent building/structures and from each other by a minimum distance as defined below or by a fire wall of two hours of fire resisting of height at least 600 mm above bushing / pressure relief vent whichever is higher.

| Oil capacity of individual transformer<br>(in liters) | Clear separating distance<br>(in Meters) |
|-------------------------------------------------------|------------------------------------------|
| 5,000 to 10,000                                       | 8.0                                      |
| 10,001 to 20,000                                      | 10.0                                     |
| 20,001 to 30,000                                      | 12.5                                     |
| Over 30,001                                           | 15.0                                     |



- 2) In case of auxiliary transformers having an aggregate oil capacity in excess of 2300 litres but individual oil capacity of less than 5000 liters, the maximum separating distance between transformers and surrounding building shall be at least 6M unless they are separated by fire separating walls or are protected by high velocity spray system.

### 33.3.8 Layout requirements for Electrical MCC/switchgear rooms

1. The following clearances shall be maintained for HT Switchboard.

**a.) Front Clearance**

- |                          |   |                 |
|--------------------------|---|-----------------|
| i) For one Row of Swgr   | - | 2.0M (Min)      |
| ii) For two Rows of Swgr | - | 2.5M (Min)      |
| b.) Back Clearance       | - | 1.5 Meter(Min.) |

**c.) Side Clearance**

Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 800+width of panel.

2. The following clearances shall be maintained for LT Switchboard.

**a.) Front Clearance**

- |                          |   |                                    |
|--------------------------|---|------------------------------------|
| i) For one Row of Swgr   | - | 1.5M (Min)                         |
| ii) For two Rows of Swgr | - | 1.5/1.75M depending upon room size |

**b.) Back Clearance**

- |                      |   |            |
|----------------------|---|------------|
| i) For single front  | - | 1.0M (Min) |
| ii) For double front | - | 1.5M(Min)  |

**c.) Side Clearance**

Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 800 mm + width of panel.

HT Switchboard clearances shall be followed wherever both LT & HT switch boards are in the same MCC room.

3. Height of HT/LT Switchgear Room

- |                      |   |             |
|----------------------|---|-------------|
| i) With Bus Duct     | - | 4.5 m (min) |
| ii) Without Bus Duct | - | 4.0 m (min) |

### 33.4 Equipment layout

While developing the layout the Bidder shall ensure the following major layout requirements:



- |     |                                                                                                    |                                                                                                                                                                                  |
|-----|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.  | Area of unloading bays                                                                             | Minimum Two (2) nos.<br>(on either end) of maintenance<br>bays for TG building shall be<br>provided.                                                                             |
| 2.  | Passage way between TG hall<br>And first row of boiler column                                      | 12 M                                                                                                                                                                             |
| 3.  | Arrangement of TG set                                                                              | Longitudinal                                                                                                                                                                     |
| 4.  | Basement, Pits & Trenches                                                                          | Regular Basement floors<br>are not acceptable in Main<br>Plant Building/Mill Bunker<br>Building.                                                                                 |
| 5.  | Clear walkways along A-row<br>& B-row of Power House.                                              | a) 1.5m at all the levels<br>of AB bay,<br><br>b) 3.0m along B-row at<br>operating floor level for<br>interconnection with<br>service building & in<br>front of control<br>room. |
| 6.  | Control Room                                                                                       | Unit control room for unit shall<br>be provided between the unit<br>at operating floor level in B-C<br>bay                                                                       |
| 7.  | Control Equipment Room                                                                             | Location of Control equipment<br>Room shall be in B-C-Dx-Ex<br>bay at operating floor level & in<br>Dx-Ex bay at mezzanine floor<br>level.                                       |
| 8.  | Minimum clear working space<br>Around the equipment                                                | 1200mm                                                                                                                                                                           |
| 9.  | Minimum clear working space                                                                        | 1500mm around the Coal mills                                                                                                                                                     |
| 10. | Minimum width of all staircase                                                                     | 1200mm                                                                                                                                                                           |
| 11. | Clear approach width between<br>Boiler & ESP                                                       | 12m minimum<br>(Height=8M)                                                                                                                                                       |
| 12. | Clear approach width between<br>ESP & ID fan                                                       | 10m minimum<br>(Height=8M)                                                                                                                                                       |
| 13. | Clear Head room within Main<br>Plant Building for pipes, ducts,<br>structures & cable trays etc.   | 2.5m (Minimum)                                                                                                                                                                   |
| 14. | Clear head room in<br>Passage bay between TG hall<br>And first row of boiler column<br>i.e. CD bay | 8m                                                                                                                                                                               |



- |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                               |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 15. | Shape of Raw Coal Bunkers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Circular                                                                                      |
| 16. | No. of Fire Escape staircases in the main plant with fire doors at each landing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Min-4 Nos. per unit-<br>However the number shall meet the requirement of insurance companies. |
| 17. | Minimum straight length in flue Gas duct at ESP outlet for Opacity meters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | As required for accurate dust measurement within the battery limits.                          |
| 18. | Coal Mills shall be located either on the side of the boiler or on rear side of the boiler i.e. between boiler and ESP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                               |
| 19. | Adequate space and provision for handling/removal of pumps, motors, heaters, heat- exchanger, fans, Mills, Switchgear Panels, Transformers during maintenance shall be provided.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                               |
| 20  | Independent floor drains with separate down comers shall be provided where fire protection system are provided.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                               |
| 21  | In TG bay at crane rail level, chequered plate walkway of minimum 750mm clear width from face of the column to the hand rail on crane side to be provided for entire A-row & B-row column sectional depth for full length of the building.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                               |
| 22. | Interconnecting walkways (minimum 2.0m clear width) between main plant building and boiler (on either side of boiler) at mezzanine, Operating, PRDS and Deaerator floor level shall be provided. Also interconnecting platform (min. 1.5m clear width) between Boiler and Coal Bunker Building at mill maintenance floor level, Feeder floor level and Tripper floor levels shall be provided by the bidder. Number of interconnecting platform between boiler and coal bunker building for each level/floor specified above shall be two numbers on each side of boiler, i.e. four numbers per floor if the mills are located on the side of the boiler and two numbers per floor if the mills are located on rear side of the boiler. |                                                                                               |
| 23. | Layout of facilities and equipment shall allow removal of Generator Stator, Generator transformers, Station & Unit transformers without disturbing equipments, piping, cabling, ducts routed in the area.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                               |
| 24. | Valves including actuators and instrument tappings shall be located in accessible positions and operating/maintenance platform for the same shall be provided. All piping shall be routed at a clear height of 2500mm (min.) from the nearest access level to clear man movement.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |
| 25. | Steam turbine and Generator and other equipments located in the turbine hall shall be accessible by the EOT cranes for their handling during erection and maintenance. Wherever special handling procedures are to be followed such as for the generator stator, rotor withdrawal of Generator etc, the same shall be described in written out document and attached with the bid. The offered layout                                                                                                                                                                                                                                                                                                                                   |                                                                                               |



of TG Hall shall be such that it shall be feasible to remove the Generator Stator and send it for repair without removal of any equipment located in TG Hall. In case removal/ erection of STG Stator calls for operation of EOT cranes in tandem then the same shall be provided. Further the complete set up including all tools required for removal, assembly & handling of Generator stator shall be provided by the Bidder. In case auxiliaries such as BFP are not in the reach of TG hall EOT crane, then separate EOT crane with proper maintenance area shall be provided along with all tools required for removal, assembly & handling of BFPs.

26. FD, ID and PA fans handling arrangement complete with crane and handling facilities along with removal space shall be provided. A continuous platform shall be provided between fan and motor end for ID/PA/FD fans in order to facilitate movement of personnel.
27. Mill handling arrangement complete with crane and handling facilities along with removal space shall be provided. For each mill bay, bidder shall provide adequate maintenance area for safely handling the mill equipments/parts.
28. Fuel oil (F.O) piping shall be routed over trestles. The headroom for F.O. Trestle in Boiler/ESP area shall be 8.0M till the road behind chimney as per the layout requirement. The headroom for F.O. trestle in outlying area shall be 3.0M except at rail/road crossing where the headroom shall be 8.0M.
29. Routing of cable trays & piping including F. O. piping & ducting-
  - I. Trestle height in outlying area shall be 3.0 M (BOS)
  - II. Trestle height from TG hall to road behind chimney /in front of TFMR yard/ Boiler/ESP area shall be 8.0 M (BOS).
  - III. Cable/Pipe trestles height at rail/road crossings shall be 8M (BOS)
  - IV. The pipes including fire water pipes shall be routed over ground either on pedestals or on trestle in plant area. No trenches for pipes shall be envisaged as far as possible. Wherever fuel oil pipes and steam pipes are running over the trestle, fire water pipes shall not be routed on the same trestle.
  - V. Head room below cable/ pipe rack in transformer yard area for movement of spare GT shall be such that the same can be moved with bushing installed. A clear gap of 500mm between top of bushing and BOS of the trestle shall be ensured.
  - VI. A walkway of 600mm (minimum width) with pipe hand rails & toe guards shall be provided all along length of the trestle for maintenance of cables & pipes. Ladders for approach to these platforms shall be provided near roads, passage ways and turning points. Wherever ash handling pipes are routed



on the trestle, one walkway of 600mm width shall be ensured on the tier meant for routing the ash handling pipes.

- VII. Wherever, dry ash pipes are routed on the top most portion of the pipe/cable trestles, a clear head room of 2.1M over the walkways of dry ash pipe rack shall be ensured.
- VIII. Head room for man movement shall be minimum 2.5m at ground floor in TG and boiler area and 2.1m over all platforms.
- IX. Height of trestles at approach roads to various buildings/facilities shall be 8M. In case building are located in off site area and are adjacent to each other, then as a good engineering practice, the height of trestle shall be maintained all over as 8.0M.
- X. Separate cable tray for optical fiber cable / UTP cable shall be provided.
- XI. The layout shall be developed so as to meet the requirements of the Cabling philosophy indicated separately (Cabling, Earthing & Lightning Protection).
- 30. Each equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of factory act and TAC.
- 31. All cranes shall be provided with approach rung ladders at least at two places. Where ever cranes can't be maintained in situ on the carriage, facility to draw them to maintenance platforms as well as provision of suitable platforms shall be considered by the bidder.
- 32. For Ventilation requirement from A-row side of TG building, space for installation of Air washer units along with pumps shall be considered in AB bay at suitable elevation. No separate room outside A-row for locating Air Washer equipment and no trestle outside A-row for routing Ventilation duct shall be considered. Further, for Ventilation requirement in BC bay, adequate space for installation of Air washer units along with pumps in BC bay for each unit shall be considered. All fresh air ventilation louvers shall be 1000 mm from floor level and directed downward at an angle.
- 33. Separate A/C systems shall be provided for Main plant, ESP Control Room & Service building. For further details relevant section of Technical Specifications may be referred.
- 34. Minimum one (1) number of staircase shall be provided between two adjacent passes of ESP. These staircases shall be equally distributed on the inlet and outlet side of ESP.
- 35. All equipment operating/maintenance platforms at Mill Hoist Level, Mill Discharge Valve level, Bunker/Feeder Outlet Level, Cold and Hot air damper level, scanner approach level, oil gun approach level, approach to bottom of hopper for ash handling and for other equipment shall be provided.



36. All equipment operating maintenance platform including supporting structures such as grating platform in the oil equipment room, control fluid equipment room, valve room, Deaerator, Gland Steam Condenser, Flash tank and for other equipment supplied and erected by the Bidder.
37. Suitable rolling shutters shall be considered in the equipment layout to be developed by the bidder on 'A'-row to facilitate the movement of Generator Transformers, Station & Unit transformers to the maintenance bay. Rolling shutter shall be provided for removal of Condenser tubes. Further rolling shutters at different location shall be provided in TG hall for the movement of material.
38. Ash slurry pipe lines shall be routed on pedestals except at road/rail crossings where pipe culverts shall be provided.
39. A suitable rail track and associated facilities like Jacking pads, mooring posts etc., shall be provided to facilitate the movement of Generator transformers. Station and Unit transformers to the maintenance bay. These rail tracks shall be accessible from the equipment unloading area of TG bay by a rail track.
40. Approach platform shall be provided from ESP outlet to ID fan suction gate.
41. Passenger cum good elevator shall be provided for approach for steam generator, station building, service building, conference room, coal handling TP in SG area, chimney for O&M and Administration building.

### **33.5 Lay down area for maintenance and overhauling.**

1. The layout of the steam turbine units shall permit sufficient lay down area for all the parts/components to enable carrying out maintenance and overhauling operations without any restrictions and without any hindrance to the operating personnel.
2. In case any special arrangement for rotor maintenance is required, the same should be provided.
3. All handling arrangement including any special arrangements like trolley, drive, pedestals etc. for carrying out maintenance and overhauling for steam turbine generator and its auxiliaries shall be provided by the bidder.
4. The Bidder shall furnish general arrangement drawings indicating the equipment lay down area with details such as blocks indicating orientation of dismantled items, travel path etc.
5. The Bidder shall also furnish general arrangement drawings indicating the lay down arrangement of major unit assemblies (provided as spares) in the TG hall with access from EOT crane. If the area provided inside TG building is not sufficient to accommodate these unit assemblies then a separate building shall be provided. The layout and arrangement shall be furnished along with the bids submitted by the bidders.



- 33.6 Local Pits/trenches in Main Plant building are to be avoided. However pits/sumps which are unavoidable such as CW (Circulating Water System) pits etc. shall be provided with required dewatering arrangements by means of drainage pumps and piping up to the nearest drainage network. Bidder shall provide required sump pumps/drainage pumps/submersible pumps & Piping etc.

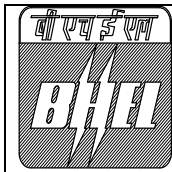
Pump shall be permanently fixed in the pits/sumps. If the pit depth is shallow, vertical top mounted sump pumps shall be provided and in deep pits self priming drainage pumps (horizontal type) at floor level or alternatively submersible type pumps may be provided.

Each pit/sump shall be provided with two numbers (2x100% Capacity) of respective type pumps so that the entire pit is evacuated within 15-20 minutes and the operation of the pumps shall be interlocked through level measurement devices to be installed in the pit/sump so that the pumps shall start automatically and empty the pit.

The general design and construction features of Vertical sump pumps and Submersible pumps are furnished elsewhere.

- 33.7 Bidder to furnish the detailed erection strategy along with the bid for major equipments located in TG hall, boiler area and ESP area.
- 33.8 Bidder's shall prepare the detailed layout of main power block area indicating the location of all major equipments. The layout shall be furnished along with the bids submitted by the bidder.
- 33.9 In addition to above, layout requirements regarding Coal Handling Plant, Ash Handling Plant and Fuel Oil Handling area buildings, specified elsewhere in the specification shall also be followed.





**TITLE:**  
**1 X 660 MW PANKI TPS EXTENSION  
PROJECT**

SPECIFICATION NO. PE-TS-426-163-A001

SECTION: II

**TECHNICAL SPECIFICATION FOR  
DM PLANT**

SUB-SECTION:II-B

REV. NO. 00

DATE :

#### **SUB-SECTION IIB**

#### **GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)**

|                                                                                   |                                                               |                                   |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------|
|  | <b>TITLE</b><br><br><b>MOTOR</b><br><br><b>DATA SHEET - C</b> | <b>SPECIFICATION NO.</b>          |
|                                                                                   |                                                               | <b>VOLUME II B</b>                |
|                                                                                   |                                                               | <b>SECTION D</b>                  |
|                                                                                   |                                                               | <b>REV NO. 00 DATE 07/05/2019</b> |
|                                                                                   |                                                               | <b>SHEET 1 OF 2</b>               |

| S. No.    | Description                                                        | Data to be filled by successful bidder |
|-----------|--------------------------------------------------------------------|----------------------------------------|
| <b>A.</b> | <b>General</b>                                                     |                                        |
| 1         | Manufacturer & country of origin                                   |                                        |
| 2         | Motor type                                                         |                                        |
| 3         | Type of starting                                                   |                                        |
| 4         | Name of the equipment driven by motor & Quantity                   |                                        |
| 5         | Maximum Power requirement of driven equipment                      |                                        |
| 6         | Rated speed of Driven Equipment                                    |                                        |
| 7         | Design ambient temperature                                         |                                        |
| <b>B.</b> | <b>Design and Performance Data</b>                                 |                                        |
| 1         | Frame size & type designation                                      |                                        |
| 2         | Type of duty                                                       |                                        |
| 3         | Rated Voltage                                                      |                                        |
| 4         | Permissible variation for                                          |                                        |
| 5         | a Voltage                                                          |                                        |
| 6         | b Frequency                                                        |                                        |
| 7         | c) Combined voltage & frequency                                    |                                        |
| 8         | Rated output at design ambient temp (by resistance method)         |                                        |
| 9         | Synchronous speed & Rated slip                                     |                                        |
| 10        | Minimum permissible starting voltage                               |                                        |
| 11        | Starting time in sec with mechanism coupled                        |                                        |
| 12        | a) At rated voltage                                                |                                        |
| 13        | b) At min starting voltage                                         |                                        |
| 14        | Locked rotor current as percentage of FLC (including IS tolerance) |                                        |
| 15        | Torque                                                             |                                        |
|           | a) Starting                                                        |                                        |
|           | b) Maximum                                                         |                                        |
| 16        | Permissible temp rise at rated output over ambient temp & method   |                                        |
| 17        | Noise level at 1.0 m (dB)                                          |                                        |
| 18        | Amplitude of vibration                                             |                                        |
| 19        | Efficiency & P.F. at rated voltage & frequency                     |                                        |
|           | a) At 100% load                                                    |                                        |
|           | c) At 75% load                                                     |                                        |

|                |           |      |      |      |  |
|----------------|-----------|------|------|------|--|
| NAME OF VENDOR |           |      | SEAL | REV. |  |
|                |           |      |      |      |  |
| NAME           | SIGNATURE | DATE |      |      |  |

|                                                                                   |                                                               |                                   |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------|
|  | <b>TITLE</b><br><br><b>MOTOR</b><br><br><b>DATA SHEET - C</b> | <b>SPECIFICATION NO.</b>          |
|                                                                                   |                                                               | <b>VOLUME II B</b>                |
|                                                                                   |                                                               | <b>SECTION D</b>                  |
|                                                                                   |                                                               | <b>REV NO. 00 DATE 07/05/2019</b> |
|                                                                                   |                                                               | <b>SHEET 2 OF 2</b>               |

| S. No.    | Description                                                                                  | Data to be filled by successful bidder |
|-----------|----------------------------------------------------------------------------------------------|----------------------------------------|
|           | c) At starting                                                                               |                                        |
| <b>C.</b> | <b>Constructional Features</b>                                                               |                                        |
| 1         | Method of connection of motor driven equipment                                               |                                        |
| 2         | Applicable Standard                                                                          |                                        |
| 3         | DOP of Enclosure                                                                             |                                        |
| 4         | Method of cooling                                                                            |                                        |
| 5         | Class of insulation                                                                          |                                        |
| 6         | Main terminal box                                                                            |                                        |
|           | a) Type                                                                                      |                                        |
|           | b) Power Cable details (Conductor, size, armour/unarmour)                                    |                                        |
|           | c) Cable Gland & lugs details (Size, type & material)                                        |                                        |
|           | d) Permissible Fault level ( kArms & duration in sec)                                        |                                        |
| 7         | Space heater details (Voltage & watts)                                                       |                                        |
| 8         | Flame proof motor details (if applicable)                                                    |                                        |
|           | a) Enclosure                                                                                 |                                        |
|           | b) suitability for hazardous area                                                            |                                        |
|           | i Zone                                                                                       | O / I / II                             |
|           | ii Group                                                                                     | IIA / IIB / IIC                        |
| 9         | No. of Stator winding                                                                        |                                        |
| 10        | Winding connection                                                                           |                                        |
| 11        | Kind of rotor winding                                                                        |                                        |
| 12        | Kind of bearings                                                                             |                                        |
| 13        | Direction of rotation when viewed from NDE                                                   |                                        |
| 14        | Paint Shade & type                                                                           |                                        |
| 15        | Net weight of motor                                                                          |                                        |
| 16        | Outline mounting drawing No (To be enclosed as annexure)                                     |                                        |
| <b>D.</b> | <b>Characteristic curves/ drawings</b><br>(To be enclosed for motors of rating $\geq 55KW$ ) |                                        |
|           | a) Torque speed characteristic                                                               |                                        |
|           | b) Thermal withstand characteristic                                                          |                                        |
|           | c) Current vs time                                                                           |                                        |
|           | d) Speed vs time                                                                             |                                        |

|                |           |      |      |      |  |
|----------------|-----------|------|------|------|--|
| NAME OF VENDOR |           |      | SEAL | REV. |  |
|                |           |      |      |      |  |
| NAME           | SIGNATURE | DATE |      |      |  |

**Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.**

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT\_CAB\_SCH\_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
  - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
  - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
  - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
  - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
  - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
  - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
  - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

|                    |                     |               |                         |
|--------------------|---------------------|---------------|-------------------------|
| A                  | NN                  | A             | NNN                     |
|                    |                     |               |                         |
| Cable              | No. of cores        | Cable code    | Cable size              |
| Voltage            | (e.g. 01,03,3H, 07) | (See C below) | (e.g. 035,185,2.5, 0.5) |
| Code (see B below) |                     |               |                         |

(A) **SYSTEM VOLTAGE CODES:**

**Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.**

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V

(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

**(B) CABLE VOLTAGE CODES:**

A = 11KV (Power cables)

B = 6.6KV (Power cables)

C = 3.3KV (Power cables)

D = 1.1KV (LV & DC system power & control cables)

E = 0.6KV (0.5 sq. mm. Control cables)

**(C) CABLE CODES**

**PVC Copper**

A = Armoured FRLS

B = Armoured Non-FRLS

C = unarmoured FRLS

D = Unarmoured Non-FRLS

**PVC Aluminium**

E = Armoured FRLS

F = Armoured Non-FRLS

G = unarmoured FRLS

H = Unarmoured Non-FRLS

**XLPE Copper**

J = Armoured FRLS

K = Armoured Non-FRLS

L = unarmoured FRLS

M = Unarmoured Non-FRLS

**XLPE Aluminium**

N = Armoured FRLS

P = Armoured Non-FRLS

Q = unarmoured FRLS

R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES

T = TOUGH RUBBER SHEATH

U = OVERALL SCREENED

V = PAIRED OVERALL SCREENED

W = PAIRED INDIVIDUAL SCREENED

Y = COMPENSATING CABLES

I = PRE-FABRICATED CABLES

Z = JELLY FILLED CABLES

**CHAPTER 26 : CABLING SYSTEM****1.00.00 SCOPE OF WORK**

The scope of work covers supply, erection, testing and commissioning of complete electrical system including cabling, fire stop mortar seal, fire retardant cable coating system etc. the scope shall broadly cover, but not be limited to:

- (a) Main power house building.
- (b) Boiler area, ESP.
- (c) Transformer yard.
- (d) All auxiliary buildings (including electrical rooms of respective buildings) and structures as per details in the General electrical specification/ plot plan/ & related drawings.
- (e) Coal handling plant.
- (f) Ash handling plant including ash dyke
- (g) Raw water system
- (h) Fuel oil unloading & transfer system.
- (i) Aux. power transformers
- (j) Pipe cum cable rack.
- (k) All electrical equipment as described in different sections.
- (l) As built drawing for all above systems on completion of project.

The scope of work shall also include all civil and structural works necessary for successful installation, commissioning & commercial operation of all electrical equipment to be erected under this specification.

**2.00.00 SCOPE OF SUPPLY**

2.01.00 The equipments and materials within the scope of supply shall include but not limited to :-

- i. Power & control cabling works (including that of special cables):
- ii. Galvanized steel pre-fabricated cable trays, coupler plates, nuts, bolts & washers, reducers, covers, wall brackets, hanger clamps, straight run, elbows, bends, cable trays supporting structures etc.
- iii. Supply and installation (including laying & termination) of control cables, special cables, instrumentation cables for all equipments and systems.

- iv. Supply and installation (including laying & termination) of all power cables (HV and LV) of all power cables (HV and LV) for all equipments and systems.
- v. Cable routing has to be planned such that it shall not cross the steam lines, oil lines.
- vi. Fire Sealing Arrangement: All cable entries into the panel (HV & MV & LV SWGR panels) should be provided with fire sealing arrangements.
- vii. Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be sealed by a fire proof sealing system (FPSS). The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.
- viii. Galvanized steel rigid/ flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanized sheet steel junction boxes, cable fixing clamps, nuts & bolts etc as required.
- ix. All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.
- x. Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved shall be deemed to be included in the scope of this specification and shall be furnished by the contractor without any extra charge to the purchaser.

### 3.00.00 CODES AND STANDARDS

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.

|                 |                                                                                                                                                |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| IS:513          | Cold rolled low carbon steel sheets and strips.                                                                                                |
| IS:1079         | Hot Rolled carbon steel sheet & strips                                                                                                         |
| IS:1239         | Mild steel tubes, tubular and other wrought steel fittings                                                                                     |
| IS:1255         | Code of practice for installation and maintenance of power cables upto and including 33 KV rating                                              |
| IS:1367 Part-13 | Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).                                 |
| IS:2147         | Degree of protection provided by enclosures for low voltage switchgear and control gear                                                        |
| IS:9537         | Conduits for electrical installation.                                                                                                          |
| IS:9595         | Metal – arc welding of carbon and carbon manganese steels - recommendations.                                                                   |
| IS:13573        | Joints and terminations for polymeric cables for working voltages from 3.3kv up to and including 33kv performance requirements and type tests. |
| IS:802          | Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.                                                         |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|                     |                                                                                          |
|---------------------|------------------------------------------------------------------------------------------|
| IS:2309             | Code of practice for the protection of building and allied structures against lighting.  |
| IS:2629             | Recommended practice for hot dip galvanising of iron & steel.                            |
| IS:2633             | Method for testing uniformity of coating on zinc coated articles.                        |
| IS:6745             | Method for determination of mass of zinc-coating on zinc coated iron & steel articles.   |
| IS:8308             | Compression type tubular in-line connectors for aluminium conductors of insulated class. |
| IS:8309             | Compression type tubular terminal ends for aluminium conductors of insulated cables.     |
| BS:476              | Fire tests on building materials and structures                                          |
| DIN 46267 (Part-II) | Non tension proof compression joints for Aluminium conductors.                           |
| DIN 46329           | Cable lugs for compression connections, ring type ,for Aluminium conductors              |
| VDE 0278            | Tests on cable terminations and straight through joints                                  |
| BS:6121             | Specification for mechanical Cable glands for elastomers and plastic insulated cables.   |
|                     | Indian Electricity Act.                                                                  |
|                     | Indian Electricity Rules.                                                                |

Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Contractor shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

#### 4.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

##### 4.00.01 Inter Plant Cabling

##### 4.01.00

Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or only cable trestle except where approved by purchaser/consultant.

Major routes in boiler area to individual boiler drives, fly ash conveying compressor building, ESP building, CW pump house, Raw water pump house, DM plant, Filter water pump house, Clarified water pump house, Fly ash silo fluidizing blower house etc will be on overhead Cable trays either supported from available structures or on pipe cum cable trestle or on only cable trestle. Only in specific areas as will be approved by purchaser/consultant where number of cables are too small compared to the route length like Intake pump house & Ash dyke, cables may be directly buried underground with marker.

Overhead trestle will be provided to the extent possible. Cable route shall be provided in such a manner that movement of crane does not get restricted and also the cables are to be routed at a safe distance from hot pipes. Generally the bottom of steel supporting structure shall be at 6.5m above the grade level. Where rail/road crossing is involved the same shall be minimum at 8m above the grade level.



Individual shallow trench shall be routed from switchyard equipment to main switchyard trench which will be routed up to Switchyard control room. Interconnecting cables from Power House to Switchyard control room shall be routed through RCC trenches. From trenches to the switchyard equipments, all power and control cables shall be laid through PVC conduit.

Space for accommodating additional trays, which may come in future shall be provided in present cable route. Some trays may be required for use by the purchaser, which will be finalized during detail engineering stage. The successful bidder shall provide such trays without any extra cost to purchaser.

For Power supply to Raw Water Intake Pump house, Cable from powerhouse will run on overhead Cable trays up to Plant boundary. After that it will be buried cable that will follow the intake pipeline corridor.

For Power supply from Power House to Main CHP Substation Building and from Main CHP Substation Building to Crusher House & Pump House, Cable will run on overhead Cable trestles. Further, Cable shall be routed through the conveyor gallery / TPs / Crusher House by separate supporting structures and trench in the pump house.

#### 4.02.00 Trenches

4.02.01 PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

4.02.02

4.02.03 All field switches for equipments corresponding to a stream located within a radius of 4-5 m shall be wired out to a field junction box and from field junction box to control panel/Input - Output cabinet by screened instrumentation cables.

4.02.04 For CHP following shall also be applicable:

- a) All cable routes shall be overhead along the route of the conveyor gallery by separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600 mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 6.5 M above the grade level except for rail/road crossings where it shall be at 8.0 M above grade level. However in bunker area the bottom of the cable trestle shall be 10 to 14 M depending on boiler/bunker layout.
- b) Cable trenches shall be provided only in Switchgear/MCC rooms.
- c) **Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc.**
- d) Cables for Pull cord switches and belt sway switches shall be taken in cable trays. The trailing cables of the mobile machines shall also be laid in cable trays.

- e) Two separate cable routes one on each side shall be provided for each boiler unit. cables for one set of auxiliaries such as ID,FD & PA fans & half of the coal mills shall be routed in one route & for through other set of auxiliaries through other route.

Cable trays in Boiler & ESP area shall be supported from the Boiler & ESP structure. The same shall be co-ordinated with SG/ESP contractors

Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in Boiler/ESP area.

Contractor shall provide two independent routes for cables between ESP control room & ESP. Contractor shall provide the cable trays along with its supporting structure arrangement on the trestle.

f) **Turbine Hall Area:**

Two separate cable routes shall be provided for cable routing of working & standby drives or different sets/groups say 50% capacity) of auxiliaries.

g) **OffSite Area:**

In offsite area pumphouses, overhead cable tray arrangement shall be preferably followed.

h) **Cable Vault:**

Cable gallery (over ground) to be provided below each electrical control/switchgear room .

Cable vault of not less than 3 mts clear height from bottom of beam shall be provided.

Clear access passage of at least 750 mm wide & 2.0 Mts clear height shall be provided at entrances & along cable ways. Wherever the passage is through cable routes clear height shall not be less than 1.5 Mts.

Cable vaults shall be provided with adequate drainage facility for drainage of fire water.

Each cable vault should have two doors.

Exit signs shall be provided near doors for personnel escape in case of emergency.

## 5.00.00 EQUIPMENT DESCRIPTION

### 5.01.00 Cable trays, Fittings & Accessories

- 5.01.01 Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates, etc.) and hardware (like bolts, nuts,



washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.

5.01.02 These shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.

5.01.03 Cable trays shall have standard width of 600 mm, however trays with 450mm, 300mm and 150mm may be used in places considering the requirement and space constraint. and standard lengths of 2.5 metre. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be minimum 3 mm.

5.01.04 Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of minimum thickness 2 mm and shall be hot dip galvanized as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.

5.01.05 Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of maximum 1.25M for horizontally and 1.0M for vertically unless design is approved for larger span. Cable trays shall be suitable for a cable weight of 100 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/86 microns respectively. The amount of zinc deposit shall not be less than 610 gm per square meter.

In areas, where acid/alkalie ingration is likely to occur, glass reinforced plstic trays with fire retardant corrosion resistance properties shall be used.

5.01.06 Cable trays fabricated from standard rolled sections shall be 50x50x6/75x75x6 sections for runners for supporting spans limited to 2000 mm/more than 2000 mm respectively. Cross support shall be 32x6 mm / 50x6 flat for widths up to 500mm/more than 500mm respectively.

5.01.07 Separate coloured paint strips shall be applied for identification of different type of trays depending upon types of usage/applications/area as below:

High/ medium voltage cables: red strips, 2 inch width each, numbers  
11kv/3.3kv equally spaced at 5 metres interval  
1.1kv power cables : yellow strips ----- do -----  
1.1kv control cables : blue strips ----- do -----  
Instrumentation cables : green strips ----- do -----

## 5.02.00 Support System for Cable Trays

5.02.01 Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".

5.02.02 Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types: (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder:

a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor



plates, all hardware such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

- b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware's fittings and accessories shall be prefabricated factory galvanised.
- c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanized surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.
- d. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.
- e. The main support channel and cantilever arms shall be fabricated out of minimum 2.5 thick rolled steel sheets conforming to IS.
- f. Cantilever arms of 300 mm, 600 mm and 750 mm in length are required. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.
- g. Cable trays in areas subjected to excessive coal dust or mechanical damage shall have hot dip galvanized sheet steel metal trays cover installed on front tray in vertical run and inverted 'V' type on upper tray in horizontal run with consideration for ventilation.

5.02.03 The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above are indicative only. Nevertheless, the support system shall be designed by the contractor to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Contractor without any additional cost. The contractor shall submit the detailed drawings of the system offered by him along with the bid.

### 5.03.00 Pipes, Fittings & Accessories

5.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.)

5.03.02 The size of the pipe shall be selected on the basis of maximum 40% fill criteria GI Pipes shall be of medium duty as per IS: 1239.

5.03.03 The contractor shall provide and install all conduits, mild steel pipes, flexible conduits, rigid PVC pipes, etc. complete with accessories like tees, bends, adopters, locknuts, pull boxes, conduit plugs, caps, etc as required for the cabling work. Conduits shall be furnished in standard length of 5 metres, threaded at both ends.

5.03.04 Conduits diameter upto and including 25mm size shall be of 16 SWG and conduits above 25 mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 20 mm.



- 5.03.05 Conduits shall be made of hot-dip galvanized steel with an organic corrosion resistant ID coating. In chemical handling areas, battery room, etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion. Conduits, fittings & accessories shall have ISI mark.
- 5.03.06 For sizes above 63 mm, hot dip galvanized - both on inside and outside - steel pipes with necessary fittings & accessories shall be provided and installed by the contractor. The pipes and fittings shall be of heavy duty class with relevant ISI mark.
- 5.03.07 Flexible conduits complying to relevant IS and made with bright, cold\_rolled, annealed and electro\_galvanized mild steel strips shall be used between embedded conduits/pipes and the motor terminals. It shall also be used between fixed conduit and any equipment with vibration or equipment requiring regular removal.
- 5.03.08 Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.
- 5.04.00 Junction Boxes**
- 5.04.01 Junction Boxes shall comprise of a case with hinged door constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3 mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.
- 5.04.02 **Glass Fibre Reinforced Junction Boxes ( for outdoor use)**
- No. of Ways: 12/24/36/48 with 20% spares terminals.
- 5.04.03 Junction boxes shall be Glass Fibre Reinforced with saturated polyester conforming to standards like DIN 16911 type 803/16913 type 834, 5 self extinguishing in accordance with ASTM D635/UL 94 VO.
- Junction boxes for use in outdoor or damp locations shall be sturdy construction. Temperature resistance shall be between – 10 to 100°C. Impact resistance shall be greater than 7 Nm, (EN 50014). Protective insulation shall be in line with VDE 0100, dielectric strength shall be greater than 10 KV/mm, halogen free toxicity, the enclosure and door cover shall be painted and electro statically power coated (preferably in RAL 7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door.
- 5.04.04 Doors
- With integrated viewing window of 3mm resistant plexi glass or equivalent. The doors shall be industrial heavy duty hinges. The doors shall be easily but firmly lockable with quick release fastener.
- 5.04.05 Protection Class
- Protection Category shall be IP 66 to EN 60529. There shall be guaranteed perfect seal to meet Protection class IP 66 providing arrangement like highly elastic foamed in special type seal like polyurethane/chloroprene. The sealing

rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 years. Contractor shall indicate this in data sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 years (double sealing arrangement is preferred).

#### 5.04.06 **Mounting clamps and accessories**

Junction boxes shall be suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass. The accessories like mounting plates etc. of steel shall be powder coated. The support rails for terminal box shall be zinc coated.

#### 5.04.07 General

- JBs shall have small canopy at the top.
- There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage into the junction box shall be avoided and it shall fall outside.
- Cable entry shall be from bottom side only.
- Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.

#### 5.04.08 **Steel Junction Boxes (for indoor use)**

#### 5.04.09 No. of Ways

12/24/36/48 with 20% spares terminals.

5.04.10 Junction boxes shall be designed in accordance with NEC, article 370, paragraph 18,19 & 20 or equivalent standards.

#### 5.04.11 Enclosure

Junction boxes for use in outdoor or damp locations shall be sturdy steel construction. The enclosure and door cover shall be surface finished clean, degreased, phosphated, deep coated primed (preferably in RAL 7044) and electro-statically powder coated (preferably in RAL 7032). Earth connection (studs size shall be M6) shall be provided on the cover as well as door. The sheath steel thickness shall be more than 2 mm.

#### 5.04.12 Doors

The doors shall be hinged and lockable. The doors shall have industrial heavy duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

#### 5.04.13 Protection Class

Protection Category shall be IP 66 to EN60529/1091 complies with NEMA 4. There shall be guaranteed perfect seal to meet Protection class IP 66 providing sealing arrangement like highly elastic foamed in special type seal like polyurethane. There shall be an arrangement like multifold protection channel for additional stability and prevention of ingress of dust and water when the enclosure is open.

The sealing rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 years. Contractor shall indicate this in data

sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 years (double sealing arrangement is preferred).

#### 5.04.14 Mounting clamps and accessories

The mounting clamps and accessories shall be suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass.

#### 5.04.15 General

- JBs shall have small canopy at the top.
- There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage in to the junction box shall be avoided and it shall fall outside.
- Cable entry shall be from bottom side only.
- Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.

5.04.16 Junction boxes shall be provided with two nos. earthing terminals (externally available) suitable for connection of 8 SWG G.I. wire. Knockouts shall be provided at bottom and both sides. These shall be provided by fixing plates in order to make them detachable type with suitable neoprene gaskets. Bottom and side plates for cable/conduit connection shall be provided. All unused holes shall be sealed with suitable grommets.

5.04.17 Junction boxes shall be provided with external designation label. The label inscriptions shall be informed to the Contractor by the Owner. Junction boxes shall be provided with danger sign in case of 415V circuit.

5.04.18 Junction boxes shall be of two types, viz. One suitable for control cabling and the other suitable for power cabling.

Junction boxes for control cabling shall have 24 way/ 48 way terminal blocks suitable for up to 2.5 sq.mm. Cu. Cable. However, for instrumentation junction boxes there shall be 24/48 ways suitable for terminating cable of 0.5 sq.mm. Cu. Cable.

5.04.19 Junction boxes for power circuit cabling shall be suitable for 1 no. 3 core 16 sq.mm. Al. Incoming cable and 1 no. 3 core 2.5 sq.mm Cu. Outgoing cable.

#### 5.05.00 Terminal blocks

Terminal blocks shall be 650 volts grade, rated for 10 Amps and in one piece, rigid, Bakelite moulded, with disconnecting /shorting link. It shall be complete with insulating barriers, Klip-on-type terminals and identification strips, terminal studs, washers, nuts, lock nuts, marking strips etc.

Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. It shall be Elmex type CSLT-1 with insulating material of Melamine conforming to ESI Standard 12.1 or equivalent. Cage clamp type terminal block suitable for terminating 2 wires of 2.5 sq mm. on both sides arranged to facilitate easy termination shall be provided.

**5.06.00 Terminations & Straight through Joints**

5.06.01 Termination and jointing kits for 11/3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 11/3.3 kV grade joints and terminations shall be type tested as per IS: 13573. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solder less crimping type cable lugs & ferrule as per DIN standard.

5.06.02 Straight through joint and termination shall be capable of withstanding the fault level for 11 kV and 3.3 kV systems.

5.06.03 1.1 KV grade straight through joints shall be of proven design.

**5.07.00 Cable glands**

5.07.01 Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene and of tested quality. Necessary cable dimensions shall be furnished to the successful contractor.

5.07.02 Cable glands shall be single compression for indoor use, double compression type for outdoor use. Glands for classified hazardous areas shall be double compression type flameproof and weather proof duly certified by CMRS and approved by CCE. Cable glands shall match with the sizes of different HT/LT/Control cables.

**5.08.00 Cable lugs/ferrules**

5.08.01 The cables lugs shall be conforming to IS: 8309.

5.08.02 Machine ferruling shall be adopted.

5.08.03 Cable lugs for power cables shall be Aluminium solder less crimping type suitable for aluminium compacted conductor cables.

5.08.04 The cable lugs for control/instrumentation/ telephone cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments.

Cable lugs shall be suitable for termination of different cross-sections of control/ instrumentation /telephone cables and shall be of following types.

- i) Copper tubular terminal end for solder less crimping to copper conductors.
- ii) Cable lugs for control cable termination shall be insulated type. These lugs shall be flat type/ring type/U type to suit the terminals provided in the panel.
- iii) Pin type lugs shall not be used.
- iv) Aluminium tubular terminal ends for solder less crimping of to Aluminium conductor.

Solder less crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

### 5.09.00 Cable Clamps & Straps

5.09.01 The cable clamps required to clamp multicore cables on vertical run shall be made up of Aluminium strip of 25x3 mm size. For clamping the multicore cables, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment.

5.09.02 Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the system short circuit current of 105 KA peak.

### 5.10.00 Galvanizing

5.10.01 Galvanizing of steel components and accessories shall conform to IS: 2629 & IS: 2633. Additionally galvanizing shall be uniform, clean smooth, continuous and free from acid spots

5.10.02 The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.

### 5.11.00 Welding

5.11.01 The welding shall be carried out in accordance with IS: 9595. All welding procedures and welders qualification shall also be followed strictly in line with IS: 9595.

### 6.00.00 CONSUMABLES AND HARDWARE

- i. The contractor shall furnish all erection materials, hardware and consumables required to complete the installation.
- ii. The materials shall include but not limited to the following:
- iii. Consumables: Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc.
- iv. Hardware: Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.
- v. Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Contractor.

### 7.00.00 METHODS AND WORKMANSHIP

- i. All work shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.



- ii. The erection work shall be supervised by competent supervisors holding relevant supervisory license from the government.
- iii. All details on installation shall be electrically and mechanically correct.
- iv. The installation shall be carried out in such a manner as to preserve access to other equipment installed.

**8.00.00 INSTALLATION****8.00.01 Cable tray and Support System Installation**

- 08.01.01 Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures. All cable trays shall be in vertical configuration in boiler, CHP, AHP & ESP areas.
- 8.01.02 Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 1500 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000 mm. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per relevant Standard. The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated in the relevant approved tray layout drawings.
- 8.01.03 All cable way sections shall have identification, designations as per approved cable way layout as and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/ stenciled with identification numbers at every floor.
- 8.01.04 In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. In such cases the Contractor shall fabricate at site suitable sections of trays, supports and accessories to make the installation complete for the specific purpose after obtaining owner's prior approval, which shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

**9.00.00 Conduits/Pipes/Ducts Installation**

- 9.01.00 The Contractor shall be fully responsible for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.
- 9.02.00 GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.



- 9.03.00 Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material.
- 9.04.00 Cable routing between lined cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 150 to the trench wall. In case of larger dia cables i.e. 50mm and above, adequately sized pipe with larger bend radius shall be provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Site Engineer.
- 9.05.00 Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

| Conduit /pipe size (dia). | Spacing |
|---------------------------|---------|
| Up to 40 mm               | 1 M     |
| 50 mm                     | 2.0 M   |
| 65-85 mm                  | 2.5 M   |
| 100 mm                    | 3.0 M   |

- 9.06.00 In areas like WTP, chemical handling, battery room etc. exterior surface of the conduits shall be further coated with chromate or polymer for better resistance to corrosion.
- 9.07.00 All G.I. pipes shall be laid as per approved layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the contractor), all the burrs from the pipes shall be removed. The bends formed shall be smooth. GI Pipes with bends shall be buried in oil/concrete in such way that that the bends shall be totally concealed. For GI pipes shall be undertaken well before paving is completed and necessary co-ordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. plugs after they are laid in final position. G.I. plugs shall be supplied by the contractor at no extra cost.

## 10.00.00 Junction Boxes Installation

- 10.01.00 Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the approved drawings or as decided by Owner and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

## 11.00.00 Cable Laying and Installation

- 11.01.00 Cable network shall include power, control, lighting, communication and fire alarm system cables, which shall be laid in trenches, cables trays/conduits as detailed in the approved drawings and cable schedules. Erection of cable trays



and aligning and leveling as required shall be the responsibility of the contractor.

- 11.02.00 Cable installation shall be carried out as per IS: 1255 and other applicable standards. Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.
- 11.03.00a. In outdoor areas, buried cables, wherever called for, shall be laid and covered with sand/riddled earth and protected from damage by bricks at sides and precast slab at top.
- b. When buried cables cross road/railway track, additional protection shall be provided in the form of hume / galvanised iron pipes/RCC box culvert.
- 11.04.00 For coal handling plant the cables shall not be routed along conveyor galleries. The cables shall be routed on independent cable trestles.
- 11.05.00 All tray levels shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. and minor adjustments shall be done to suit the field conditions wherever deemed necessary. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings. The contractor shall have to secure rack/tray supports by welding to those inserts, suitable embedded steel inserts shall be provided. Outdoor trays shall be installed by welding on the steel/concrete structure with inserts by the contractor. As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.
- 11.06.00 While laying cable, ground rollers shall be used at every 2 metre interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables.
- 11.07.00 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all cables shall be tapped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted.

- 11.08.00 Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel or at right angles to beams, walls columns. Cables shall be so routed that they will not be subjected to heat from adjacent hot piping or vessels.
- 12.00.00 Laying of cables in cable trays**
- 12.01.00 Cables shall be laid on cable trays strictly in line with cable schedule furnished. Where specific cable layouts are not shown on approved drawings, contractor shall route these as directed by the Owner.
- 12.02.00 Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.V. cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. LT power cables above 95 sq.mm size shall be laid in single layer touching formation in trays while cables upto & including 95 sq.mm shall be laid in maximum of 2 layers. Control and Instrumentation cables can be laid upto a maximum of three layers in each tray.
- 12.02.00 All communication cables (telephone, P.A. System) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench/trays with a minimum clearance of 600mm away from electrical trench/trays as per the direction of Site Engineer and Communication cables shall cross power cables at right angles
- 12.03.00 Power and control cables shall be secured fixed to trays/support with self locking type nylon cable straps with de-interlocking facilities. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by aluminium strips at every five meter interval and at every bend.
- 12.04.00 Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255.
- 12.05.00 Individual cables or small groups which run along structures/walls etc will be clamped by means of 16 SWG GI saddles on 25x6mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables. Alternatively small group of cables can be taken through 100mm slotted channel/ISMC 100.They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be drilled where the minimum weakening of the structure will result.
- 12.06.00 Cables shall be supported so as to prevent unsightly sagging. In general distance between supports shall be approximately 300mm for cables upto 25mm diameter and maximum 500mm for cables larger than 25mm dia and

- cables laid in vertical run of cable trays shall be clamped at an interval of 900mm.
- 12.07.00 Where cables cross roads/rail tracks, the cables shall be laid in Hume pipe/PVC pipe. At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends. the hume pipes shall be laid at a depth of minimum 1000mm such that cables are not damaged.
- 12.08.00 Power and Control Cables, as far as possible, shall be laid in complete, uncut lengths from one termination to the other. Straight through joints in power cable shall be allowed only in nearest of rare situation only after approval of owner.
- 12.09.00 Joints for less than 250 Meters run of cable shall not be permitted.
- 12.10.00 In each cable run some extra length shall be kept at suitable point to enable one LV/two HV straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.
- 12.11.00 Wherever few cables are branching out from main trunk route troughs shall be used.
- 12.12.00 Cables shall be neatly arranged in the trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trays shall be the responsibility of the contractor.
- 12.13.00 The contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works. Before the start of cable laying, cable drum schedule shall be prepared by electrical contractor and get that approved by site engineer to minimize/avoid straight through joints. The actual number of straight through joints required shall be worked out by the contractor. During the erection period the contractor shall furnish a monthly report on cable position in an approved proforma so as to keep the owner appraised of the position.
- 12.14.00 The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.
- 12.15.00 Electrical cable trays exposed to hazardous process fluid shall be covered with detachable G.I. covers. The covers shall be suitable to resist wind forces.
- For cables laid above ground in cable racks, asbestos sheeting of 3mm thickness shall be provided below the bottom cable tray to protect the cables from fire.
- 12.16.00 Supporting steel shall be painted before laying of cables. The painting shall be done with one coat of red lead paint and two coats of approved bituminous aluminium paint unless otherwise specified.

**12.17.00 Separation**

Sufficient spacing not less than 300mm shall be provided between different tiers of trays and maintained to permit adequate access for installation and maintenance of cables.

At least 300mm clearance shall be provided between :

- HV power & LV power cables,
- LV power & LV control/instrumentation cables,

**12.19.00 Segregation**

Segregation means physical isolation to prevent fire jumping.

Cables from two different services viz. supply from Station Board and Unit Board shall be segregated.

Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

For Coal Handling Plant all the cables of one stream shall be segregated from the cables of the other stream and shall run on either side of the trestle.

**13.00.00 Cable fire sealing**

**13.01.00** Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be sealed by a fire proof sealing system (FPSS). The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.

**13.02.00** Wherever the cables/cable trays pass through walls/floors, fire proof cable penetration seals rated for one-twenty (120) minutes shall be provided. This shall be by suitable block system using individual blocks with suitable framework or by silicon RTV foaming system. In case foaming system is offered, damming board, if used, shall not be considered for fire rating criteria. Any of the system offered shall be of proven type as per BS: 476 (Part-20) or equivalent standard.

**13.03.00** In order to prevent fire propagation through cable penetrations, after laying, dressing & clamping of cables, all the openings shall be properly sealed by using Fire Stop Mortar Seal and Fire Retardant Cable coating compound. Also the cable runs both before and after the fire scale shall be suitably sprayed with anti-fire propagation liquid.

**14.00.00 Cable laying in trenches**

**14.01.00** RCC cable trenches with removable covers will be provided by the contractor. Cables shall be laid in 3 or 4 tires in these trenches. Concrete cable trenches shall be filled with sand where specified to avoid accumulation of hazardous gases. RCC covers of trenches in process area shall be effectively sealed to avoid ingress of chemicals etc. Removal of concrete covers for purposes of



cable laying and reinstating them in their proper positions after the cables are laid shall be done by the contractor at no extra cost.

- 14.02.00 For cable trays are laid in trench in more than two tiers a space of minimum 600 mm shall be available for maintenance. In case two or more tiers of cable trays are running parallel along both sides of trench walls there shall be space of minimum 600 mm between them.
- 14.03.00 Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cable leaving trenches shall be coiled and provided with a protective pipe or cover till such times the final termination to the equipment is completed.
- 14.04.00 Prior to laying of cables inside both indoor and outdoor trenches, the contractor shall properly clean inside of those trenches.
- 14.05.00 When cables are laid in multiple tiers, spacing between individual tiers shall be as approved by Site Engineer. Space between individual tiers shall be filled and compacted with soil and sand.
- 14.06.00 As each row of cables is laid in place and before covering with sand every cable shall be given on insulation test in the presence of Site Engineer. Any cable, which proves defective, shall be replaced before the next groups of cables are laid.
- 14.07.00 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench.
- 14.08.00 Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection up to a minimum of 150mm above grade.
- 14.09.00 Cable ends shall be carefully pulled through the conduit, to prevent damage to these cables. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.

Following guide of the pipe fill shall be used for sizing the pipe size:

- a) 1 cable in pipe - 53% full
- b) 2 cables in pipe - 51% full
- c) 3 or more cables - 43% full
- d) Multiple cables - 40% full

After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/'PUTTI' for sealing purpose. Alternatively G.I. Lids or PVC bushes shall be employed for sealing purposes. The cost for the same shall be deemed to have been included in the installation of G.I. pipe and no separate payment shall be allowed.

- 14.10.00 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or



structures, the electrical contractor shall determine their location and obtain approval of the Site Engineer before cutting is done.

### 15.00.00 CABLE IDENTIFICATION

15.01.00 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry & exit, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties of 'TY-CAB' or equivalent type with cable number heat stamped on the cable tags.

15.02.00 For laying of underground cable (applicable for Raw Water Intake Switchgear & Ash dyke) shall be provided with identity tags of Stain less steel securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground. In unpaved areas cable trenches shall be identified by means of markers. These posts shall be placed at location of changes in the direction of cables and at intervals of not more than 30 M for straight run and at cable joint locations with additional inscription 'Cable Joint'. For buried cables the marker shall project 150mm above ground.

15.03.00 Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.

### 16.00.00 CABLE TERMINATIONS & CONNECTIONS

16.01.00 The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Site Engineer. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.

16.02.00 Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Site Engineer.

16.03.00 Responsibility of proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by the contractor.

16.04.00 The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.



- 16.05.00 Contractor shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables. If the cable end box or terminal chamber provided on the equipment is found unsuitable and requires major modifications the same shall be carried out by the contractor at the discretion of the Engineer- in-Charge.
- 16.06.00 Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.
- 16.07.00 The panels where a larger number of cables are to be terminated and cable identification may be difficult, each core ferrule shall include the complete cable number. The ferrules shall be indelible interlocking type and shall fit tightly on cores. Spare cores shall have similarly ferrules with a suffix letter 'S' alongwith cable numbers and coiled up after end sealing.
- 16.08.00 All cable terminations shall be appropriately tightened to ensure secure and reliable connections.
- 16.09.00 It is the responsibility of the Contractor to terminate the cables at motor terminals in correct phase sequence to ensure the proper direction of rotation.
- 16.10.00 All cables upto 1.1KV grade shall be terminated at the equipments by means of compression type cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.
- 16.11.00 All cable entries shall be through bottom only and top entry terminations are made only after getting approval of Site Engineer.
- 16.12.00 Power cables, wherever colour coding is not available, shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections is made, necessary bimetallic washers shall be used. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.
- 16.13.00 In case of control cables all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules. Wire numbers shall be as per schematic/ wiring/ inter-connection diagram. Contractors shall have the samples of PVC markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends. Control cables shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.
- 16.14.00 Where threaded cable gland is screwed into threaded opening of different size, suitable brass threaded reducing bushing shall be used provided.
- 16.15.00 The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals.

In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom, close fit hole should be drilled in the bottom plate for all the cables in one line, and then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.

- 16.16.00 Cable leads shall be terminated at the equipment terminals by means of crimped type solder less connectors.

Crimping shall be done by hand crimping/hydraulically-operated tool and conducting jelly shall be applied on the conductor.

Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open.

- 16.17.00 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.

- 16.18.00 All cable entry points shall be properly sealed and made dust and vermin proof. Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least one-twenty (120) minutes.

#### 17.00.00 Cable accessories for H.V. Systems

- 17.01.00 The H.V. cables terminations/joints shall be done by skilled and experienced jointers duly approved by the Site Engineer.

- 17.02.00 The termination and straight through joint kits for use on high voltage system shall be suitable for the type of cables offered by the contractor or the type of cables issued by owner for installation. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction shall be included in each kit.

- 17.03.00 The termination kits shall be suitable for termination of the cables to an indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer/motor. The termination kits shall preferably be as of the following types.

- a. 'PUSH ON' type for LV cables.
- b. Heat-shrinkable sleeve type for LV & HV cables.

However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of owner.

For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

- 17.04.00 The straight through jointing kits shall be suitable for underground buried installation with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be one of the following types.

- a. 'TAPEX' of M-seal make or equivalent for LV cables
- b. Heat-shrinkable sleeve type for LV & HV cables.



However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of owner.

For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

### 18.00.00 EXCAVATION AND BACK FILLING

- 18.01.00 The contractor shall perform all excavations and backfilling as required for buried cable and ground connections.
- 18.02.00 Excavation shall be performed up to the required depth. Such sheeting and shoring shall be done as may be necessary for protection of the work.
- 18.03.00 The contractor shall make use of his own arrangement for pumping out any water that may be accumulated in the excavation.
- 18.04.00 All excavation shall be backfilled to the original level with good consolidation.

### 19.00.00 CLEANING UP OF WORK SITE

- 19.01.00 The Contractor shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.
- 19.02.00 Upon completion of work, the contractor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

### 20.00.00 QUALITY ASSURANCE PROGRAMME

- 20.01.00 Contractor shall furnish detailed Quality Assurance Programme and Quality Plans for all materials and accessories to be supplied and installed under the scope of the specification as per General Technical Conditions of technical specification. The Quality Plans shall include all tests/ checks as per relevant National/International Standards and the requirements of this specification including tests listed in this section.

### 21.00.00 TESTS

#### 21.01.01 Type tests on Cable Trays support system

##### A) Test 1A:

**On main support channel type-C2 for cantilever arms fixed on one side only.** A 3.5 metre length of main support channel shall be fixed vertically at each end to a rigid structure as per appropriate fixing arrangement. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the following load intervals and other necessary points:

- i) Working load



- ii) Working load + point load
- iii) Off load
- iv) Proof load + point load
- v) Off load

The deflection measured at working loads shall not exceed 16 mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.

**B) Test 1B:**

Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2

**Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides**

**a) Test 2A:** A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per appropriate fixing arrangement. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at the following load intervals and other necessary points.

- i) Working load
- ii) Working load + Point load

iii) Off load

- iv) Proof load + Point load
- v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied

**b) Test 2B:** The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side.

**Test 3:**

A length of main support channel section shall be fixed to steel structure/floor and have loads applied as detailed below and other important points not mentioned herein.

**a) Test 3A :** A length of steel structure shall be rigidly supported. It should be fitted on a metre length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place.

- b) **Test 3B:** With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place.
- c) **Test 3C:** With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line.  
The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded.

**Test 4** Channel nut slip characteristics (what ever applicable)

**Tests 4A1, 4A2, 4A3:**

A length of channel C1 section 200 mm long shall have fitted bracket with the two bolts fixing.

With loads applied at the appropriate position nut slip shall be determined with bolt torque of 30 NM, 50 NM and 65 NM No fewer than three measurements shall be made or each torque setting.

A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM.

**Tests 4B1, 4B2, 4B3:**

The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing. With loads applied at the appropriate position, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting.

A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM

**Test 5 Weld Integrity Test**

After deflection test as per test 1A, 1B, 2, 3 & 4 weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any.

Cable termination kit and straight through joints should have been tested as per IS: 13573 for 3.3kV and 11kV class.

Fire proof Cable Penetration system should have been tested for the following tests:

- Accelerated Ageing test
- Water absorption test
- Fire rating test
- Hose Stream test
- Vibration test followed by fire rating test

**21.02.00 Routine/ Acceptance Tests**

Following routine/acceptance tests shall be carried out on all the equipments, devices & materials supplied:

**22.00.00 Galvanizing Tests**



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



The quality of galvanizing shall be inspected visually and shall be smooth, continuous, and free from flux stains.

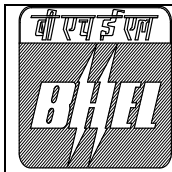
- i) Uniformity of coating – The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.
- ii) The quality of cadmium/zinc plating on items with screw threads shall be inspected visually and shall be free from visible defects such as unplanted areas, blisters and modules.
- iii) In addition, the plating thickness shall be determined microscopically/chemically or electronically.

### 23.00.00 Welding

The quality of welding shall be visually inspected, particular attention being paid to the following points.

- 1) The welded joints shall be continuous along its length on both sides and of uniform width and thickness. It should be free from blow holes.
- 2). The weld metal shall be properly fused with the parent metal without undercutting.
- 3) The outside surface of the weld shall be clean. All slag shall have been removed. All welding shall be regularly checked for cracking using magnetic particle inspection or their equivalent technique.
  - 1. Physical and dimensional checks for all items.
  - 2. All conduits/pipes, etc. shall be routine/acceptance tested as per relevant standards.
  - 3. All acceptance and routine tests on cable glands as for BS: 6121. Additionally Proof torque test shall be carried out as acceptance on each body group of cable glands.
  - 4. Deflection test cable trays.
  - 5. All acceptance and routine tests on Junction boxes.
  - 6. Following tests shall also be carried out on each type of equipments, devices and materials/items supplied:
    - i) Physical and Dimensional checks
    - ii) Check/measurement of thickness for Nickel chrome plating for cable glands and tinning for cable lugs.
    - iii) Check chemical composition of brass parts for cable glands.
    - iv) Hardness check on gaskets.
    - v) Test for uniformity of galvanization.

- 1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories.
- 2) Check for continuity of cable trays over the entire route.
- 3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.
- 4) Check for earth continuity and earth connection of cable trays.



**TITLE:**  
**1 X 660 MW PANKI TPS EXTENSION  
PROJECT**

**TECHNICAL SPECIFICATION FOR  
DM PLANT**

SPECIFICATION NO. PE-TS-426-163-A001

SECTION: II

SUB –SECTION: IIC

REV. NO. 00

DATE :

#### **SUB-SECTION IIC**

#### **GENERAL TECHNICAL REQUIREMENTS (CONTROL & INSTRUMENTATION)**



Technical specification  
for  
1X660 MW TPS PANKI EXTN.

REV. NO. 00 DATE : 25.04.19

# C&I SPECIFICATION

## FOR

### DM PLANT (DCS Based)



Technical specification  
for  
1X660 MW TPS PANKI EXTN.

REV. NO. 00 DATE : 04.04.2019

# INSTRUMENTS, JB & VALVES SPECIFICATIONS

## CHAPTER-2: FIELD AND MEASURING INSTRUMENTS

### 2.00.00 MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

- 2.00.01 Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section/chapter 1, Vol. V, Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Owner's approval.
- 2.00.02 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.
- 2.00.03 All transmitters, sensors, and switches, Gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Bidder shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Owner during detailed engineering.
- 2.00.04 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.
- 2.00.05 For corrosive applications, all instruments applications, they shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if proven ness experience of the proposed material for such applications is established by bidder).
- All instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.
- 2.00.06 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1/2, Division 1 area & Flame proof area) and an anti corrosive paint shall be applied to the field mounted enclosures / instruments.



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



In general, double cable entry shall be provided, wherever available, unused cable entry shall be provided with blind metal plug. All the field instruments shall also be provided with SS tag nameplate. Counter and mating flange (SS316 material), fastener, gaskets, Nuts, bolts etc. shall also be included wherever required with the field instruments.

- 2.00.07 In general, front draw out type instruments with plug-in facility at the rear for connecting cables for power supply and signal shall be provided unless otherwise specified like for Explosion proof area, Flame proof area and high vibration prone area. Separate plugs & socket connection shall be provided for connecting power supply cables and signal cables.

The plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.

Signal and Electrical connection shall be screwed connection with double compression type Nickel-plated brass/SS316 cable glands (Material as decided by owner) for Explosion proof area, Flame proof area and high vibration prone area.

- 2.00.08 The quantity of secondary instruments etc. to be provided by Bidder shall be adequate to meet the requirements of Technical Specifications. Any other additional quantity of secondary instruments envisaged by Bidder as per system and process requirements shall also be supplied without any cost implication.

## **2.01.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS**

### **2.01.01 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF. PRESSURE AND DP BASED FLOW, LEVEL MEASUREMENTS**

| <b>Sl. No.</b> | <b>Features</b>     | <b>Essential/Minimum Requirements</b>                                                                                                                                                   |
|----------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>       | Type of Transmitter | Microprocessor based 2 wire type, Hart protocol compatible                                                                                                                              |
| <b>2</b>       | Accuracy            | ± 0.1% of calibrated span (minimum) (upto turn down ratio of 10:1).                                                                                                                     |
| <b>3</b>       | Output signal range | 4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)                                                                                                     |
| <b>4</b>       | Turn down ratio     | 10:1 for vacuum/very low pressure applications.<br><br>5:1 for very high pressure application.<br><br>30:1 for other applications.                                                      |
| <b>5</b>       | Stability           | ± 0.1% of calibrated span for six months for Ranges up to and including 70Kg/cm <sup>2</sup> .<br>± 0.25% of calibrated span for six months for Ranges more than 70Kg/cm <sup>2</sup> . |
| <b>6</b>       | Zero and span drift | +/- 0.015% per deg.C at max span.                                                                                                                                                       |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|           |                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |                                                                                                              | +/- 0.011% per deg.C at min. span.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>7</b>  | Load impedance                                                                                               | 500 ohm (min.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>8</b>  | Housing                                                                                                      | Weather proof as per IP-65 with durable corrosion resistant coating.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>9</b>  | Over Pressure                                                                                                | 150% of max. Operating pressure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>10</b> | Connection (Electrical)                                                                                      | Plug and socket type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>11</b> | Process connection                                                                                           | 1/2 inch NPT (F)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>12</b> | Span and Zero                                                                                                | Continuous, tamper proof, Remote as well as adjustability manual from instrument with zero suppression and elevation facility                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>13</b> | Material                                                                                                     | Die cast Aluminum with epoxy coating/SS316 for body. SS316 for Diaphragm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>14</b> | Accessories                                                                                                  | <p>-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.</p> <p>- LCD/TFT digital integral Indicators with scale of Engg. Units.</p> <p>-2 valve SS316 manifold for absolute &amp; Gauge pressure transmitters, 3-valve SS316 manifold for vacuum pressure transmitters &amp; where DP transmitters are being used for pressure measurement and 5 valve SS316 manifold for DP/Level/Flow applicable.</p> <p>Transmitters should not be mounted directly on the manifold; Manifold shall be non integral type only.</p> <p>- Snubbers/Pulsation dampners shall be used where the process media is unstable for measurement such as the discharge of a pump.</p> <p>-For hazardous area, explosions proof enclosure as described in NEC article 500.</p> |
| <b>15</b> | Diagnostics                                                                                                  | Self Indicating feature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>16</b> | Power supply                                                                                                 | 24V DC $\pm$ 10%.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>17</b> | Adjustment/calibration From hand held calibrator/centralized OWS based system n/maintenance (as applicable). | From hand held calibrator/centralized OWS based system                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



**Notes**

For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement.

LVDT type is not acceptable.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

**2.02.00 Specification for Pressure Gauge, D.P Gauge, Temperature Gauge and Level Gauge**

| s. no. | Features                     | Essential minimum requirements                                     |                                                                                                                  |                                                                                          |
|--------|------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
|        |                              | Pr. Gauge/DP Gauge/Draught gauges                                  | Temperature gauge                                                                                                | Level Gauge                                                                              |
| 1      | Sensing Element and Material | Bourdon for high pressure, Diaphragm/ Bellow for Low pr. Of SS 316 | Mercury in Steel/Bimetallic type for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary | Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type. |
| 2      | Body Material                | Die Cast Aluminum with stoved enamel black finish /SS316           | Die Cast Aluminum with stoved enamel black finish /SS316                                                         | Forged carbon steel/SS 304                                                               |
| 3      | Dial Size                    | 150 mm with toughened shatter proof glass                          | 150 mm with toughened shatter proof glass                                                                        | Tubular covering entire range                                                            |
| 4      | End Connection               | ½ inch NPT (M)                                                     | ¾" NPT (M)                                                                                                       | Process connection as per ASME PTC and drain/vent 15 NB                                  |
| 5      | Accuracy                     | +/- 1% span                                                        | +/- 1% span                                                                                                      | +/- 2%                                                                                   |
| 6      | Scale                        | Linear, 270° arc graduated in metric units                         | Linear, 270° arc graduated in °C                                                                                 | Linear vertical                                                                          |
| 7      | Range Selection              | Cover 125% of max. of scale                                        | Cover 125% of max. of scale                                                                                      | Cover 125% of max. of scale                                                              |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|    |                               |                                                                                                                  |                                     |                                                                                                                          |
|----|-------------------------------|------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| 8  | Over range test               | Test pr. For the assembly shall be 1.5 to the max.<br>Design pr. At 38°C                                         |                                     |                                                                                                                          |
| 9  | Housing                       | Weather and dust proof as per IP-65                                                                              | Weather and dust proof as per IP-65 | CS/304 SS leak proof.                                                                                                    |
| 10 | Zero/span Adjustment          | Provided                                                                                                         | Provided                            | -                                                                                                                        |
| 11 | Identification                | Engraved with service legend or laminated phenolic name plate                                                    |                                     |                                                                                                                          |
| 12 | Accessories                   | Blow out Disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve | SS316 Thermowell                    | Gasket for all KEL-F shield for transparent type vent and drain valves of steel/SS as per CS/ alloy process requirement. |
| 13 | Material of Bourdon/ movement | SS 316                                                                                                           | SS 316                              |                                                                                                                          |

Notes – \*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with inert liquid suitable for the application.

### 2.03.00 GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER

|                                                                                                                                                                    |                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Guided wave radar type level transmitters shall be provided for level measurements of the vessel under vacuum or low pressure applications as specified in Part-A. |                                                                                    |
| Type                                                                                                                                                               | Guided wave Radar                                                                  |
| Principle                                                                                                                                                          | TDR (Time domain reflectometry)                                                    |
| Probe Type & Material                                                                                                                                              | Coaxial, SS316/316L. If required, probe shall be suitable for overfill prevention. |
| Connection type and material                                                                                                                                       | Flanged and SS316/316L.                                                            |
| Signal o/p                                                                                                                                                         | 4-20mA with HART signal suitable for overfill prevention.                          |
| Display                                                                                                                                                            | Integral                                                                           |
| Power supply                                                                                                                                                       | 24 VDC                                                                             |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|                                                                                                                                                                                                                             |                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Accuracy                                                                                                                                                                                                                    | 5mm                                                                                                                                                                                                 |
| Electromagnetic compatibility                                                                                                                                                                                               | Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 50082-2                                                                                                                  |
| Housing material                                                                                                                                                                                                            | Die cast Aluminum/SS316.                                                                                                                                                                            |
| Vent & Drain Plug material                                                                                                                                                                                                  | SS 316                                                                                                                                                                                              |
| Local Display                                                                                                                                                                                                               | LCD digital type, configured in engg. Units.                                                                                                                                                        |
| Accessories                                                                                                                                                                                                                 | Integral cable between sensor and transmitter unit with connectors on both side, gasket and cable gland, digital panel meter, name plate and metal tag. All material of accessories will be SS 316. |
| Mounting                                                                                                                                                                                                                    | External cage mounting                                                                                                                                                                              |
| The transmitters shall be provided with IP-65 protection class with durable corrosion resistant coating.<br>The transmitters shall be able to provide digital signals super imposed on 4-20 mA signal as per HART protocol. |                                                                                                                                                                                                     |

#### 2.04.00 Ultrasonic Type level Transmitter

| Sl.No. | Features                           | Essential/Minimum requirement                                                                                                                                              |
|--------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | Type of Transmitter                | Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter. Also refer note-3.                                                          |
| 2.     | Output signal                      | 4-20mA DC (Analog) along with superimposed digital signal (based on HART protocol)                                                                                         |
| 3.     | Sensor Accuracy                    | +/- 0.5% of calibrated span.                                                                                                                                               |
| 4.     | Sensor Repeatability               | 3mm or better                                                                                                                                                              |
| 5.     | Power supply                       | 24 V DC +/-10%                                                                                                                                                             |
| 6.     | Temperature compensation           | To be provided within transducer                                                                                                                                           |
| 7.     | Configuration                      |                                                                                                                                                                            |
| 8.     | Housing                            | Weather proof as per IP-65 with durable corrosion resistant coating.                                                                                                       |
| 9.     | Adjustment/Calibration/maintenance | From hand held calibrators/ centralized OWS HART based system (as applicable)                                                                                              |
| 10.    | Zero and Span adjustment           | Continuous, tamper proof, remote as well as manual adjustability from instrument. It shall be possible to calibrate the instrument without any level in the tank/sump etc. |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                        |                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Sensor Material        | Corrosion resistant material to suit individual application requirement.                                                                                                                                                                                                                                                                            |
| 12.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | False signal tolerance | Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry                                                                                                                                               |
| 13.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Range                  | Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.                                                                                                                                                                 |
| 14.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Display                | LCD display with integral keypad to be provided.                                                                                                                                                                                                                                                                                                    |
| 15.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Diagnostics            | Loss of echo alarm etc.                                                                                                                                                                                                                                                                                                                             |
| 16.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Load Impedance         | 500 ohms minimum.                                                                                                                                                                                                                                                                                                                                   |
| 17.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Electrical Connection  | Plug and socket.                                                                                                                                                                                                                                                                                                                                    |
| 18.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Accessories            | <ul style="list-style-type: none"> <li>All weather canopy for protection from direct sunlight and direct rain.</li> <li>All mounting hardware and accessories required for erection and commissioning mounting fittings materials shall be SS 316.</li> </ul> <p>For hazardous area, explosion proof enclosure as described in NEC article 500.</p> |
| <p><b>Note:-</b></p> <p>1) Bidder can also provide Radar type transmitter in place of ultrasonic transmitters subject to approval by Owner during detailed Engineering.</p> <p>2) The frequency used for Ultrasonic /sonic measurements shall be suitable for envisaged applications and this shall be supported by the standard product catalogue of the instrument manufacture.</p> <p>3) Four wire type transmitters can also be provided subject to Owner's approval during detailed engineering stage. However, in such cases isolated 4-20mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 24V DC for main plant and CW system applications. Power supply can be 240V AC (UPS) / 24V DC for other application.</p> |                        |                                                                                                                                                                                                                                                                                                                                                     |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|  |                                                                                                                                                                                                                                                                                                                                                     |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | 4) Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided by owner during detailed engineering.<br>Separate Sensor unit & electronics unit with LCD display to be provided for the applications, which will be decided during detailed engineering by owner. |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**2.05.00****HART Hand Held calibrator**

Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible 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.

HART hand held calibrator shall be provided with following minimum accessories per set:-

- i. Soft carrying case with adjustable shoulder straps & lead compartments.
- ii. HART lead set.
- iii. Rechargeable batteries.
- iv. Battery charger.
- v. Power adaptor.
- vi. Universal plug kit for power adaptor.
- vii. Load resistor.
- viii. Interfacing cables of each type as per requirements.
- ix. Protective boot.
- x. Standard banana jack.
- xi. Operation manual & software CD.

The quantity of HART hand held calibrator to be provided by Bidder is listed in Appendix- I to Vol.V, Table IV, Part A of Technical Specifications.

**2.06.00****Temperature Elements and accessories****2.06.01****Thermocouples**

| S.No. | Features             | Essential/Minimum Requirements                                                                                                             |
|-------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1.    | Type of Thermocouple | 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type S/R) depending on operating temperature Range (ungrounded type). |
| 2.    | No. of element       | Duplex                                                                                                                                     |
| 3.    | Housing/Head         | IP-65/Die cast Aluminum. Head of TE to be provided with sufficient space and arrangement to head                                           |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|     |                             |                                                                                                                              |
|-----|-----------------------------|------------------------------------------------------------------------------------------------------------------------------|
|     |                             | mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. |
| 4.  | Sheathing of Thermocouple   | Swaged type magnesium oxide insulation                                                                                       |
| 5.  | Calibration and accuracy    | As per IEC-751/ANSI-C-96.1(special class) for T/C                                                                            |
| 6.  | Characteristic              | Linear with respect to temp, within $\pm 1/2$ percent of top range value                                                     |
| 7.  | Accessories                 | Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.                             |
| 8.  | Standard                    | ANSI C 96.1 for Thermocouple and ASME PTC-19.3 (latest edition) for Thermo-well.                                             |
| 9.  | Sheath Material/ Insulation | 316SS/Compacted Magnesium Oxide.                                                                                             |
|     | Sheath O D                  | 8 mm.                                                                                                                        |
| 10. | Response Time               | 6-10 Sec bare & 30 Sec. With protective sheath/thermowell                                                                    |
| 11. | Instrument Connection       | 1/2 " NPT (F).                                                                                                               |
| 12. | Electrical connection       | Gold plated Plug in type. Double entry, one unused entry with blind plug.                                                    |
| 13. | Enclosure Class             | IP-65 or better.                                                                                                             |
| 14. | Process Connection          | i) M33 x 2<br>ii) Flanged for Air & Gas systems with mating flanges, fastner, gasket etc.                                    |
| 15. | Extension                   | Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends                        |
| 16. | Extension neck length       | Minimum 100 mm above Insulation of pipe and Minimum 160 mm when there is no insulation on pipe.                              |

### Notes

1. Extension cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

2. Thermocouples provided for steam services like super heater / de super heater area, where the process pipe is inside the insulation of boiler penthouse, Thermowells are inaccessible and terminal head and connecting cable cannot withstand high temperature, for such services thermocouples shall be provided with flexible extension SS316 Sheath of 10-15 meters.
3. The specification for thermocouples of bearings metal and winding 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.

#### 2.06.02 Resistance Temperature Detector (RTD)

| S.No. | Features                    | Essential/ Minimum Requirements                                                                                                                                                                                                    |
|-------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.    | Type of RTD                 | Four /Three wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).                                                                                                                                                          |
| 2.    | No. of element              | Duplex                                                                                                                                                                                                                             |
| 3.    | Housing/Head                | IP-65/Diecast Aluminum. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. |
| 4.    | Sheathing of RTD            | Metal sheathed, ceramic packed                                                                                                                                                                                                     |
| 5.    | Calibration and accuracy    | As per DIN-43760/IEC 60751 Class-A for RTD                                                                                                                                                                                         |
| 6.    | Characteristic              | Linear with respect to temp, within $\pm 1/2$ percent of top range value.                                                                                                                                                          |
| 7.    | Accessories                 | Thermo well (as specified below) and shall be spring loaded for positive contacts with the well                                                                                                                                    |
| 8.    | Standard                    | DIN-43760/IEC 60751 for RTD and ASME PTC-19.3 (latest edition) for Thermo-well.                                                                                                                                                    |
| 9.    | Sheath Material/ Insulation | 316SS/Compacted Magnesium Oxide.                                                                                                                                                                                                   |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|     |                       |                                                                                                       |
|-----|-----------------------|-------------------------------------------------------------------------------------------------------|
|     | Sheath O D            | 8 mm.                                                                                                 |
|     | Gauge                 | 18 SWG                                                                                                |
| 10. | Response Time         | 6-10 Sec bare & 30 Sec. With protective sheath/thermowell                                             |
| 11. | Instrument Connection | 1/2 " NPT (F).                                                                                        |
| 12. | Electrical connection | Gold plated Plug in type. Double entry, one unused entry with blind plug.                             |
| 13. | Enclosure Class       | IP-65 or better.                                                                                      |
| 14. | Process Connection    | i) M33 x 2<br>ii) Flanged for Air & Gas systems with mating flanges, fastner, gasket etc.             |
| 15. | Extension             | Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends |
| 16. | Extension neck length | Minimum 100 mm above Insulation of pipe and Minimum 160 mm when there is no insulation on pipe.       |

**NOTES:**

- 1) The specifications for RTDs of winding/ bearings 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 PT100.

**2.06.03 Metal Temperature Thermocouples**

| S.No. | Features                        | Essential / Minimum Requirements                                                              |
|-------|---------------------------------|-----------------------------------------------------------------------------------------------|
| 1.    | Measuring Medium                | Metal Temperature                                                                             |
| 2.    | Material of Thermocouple        | Chromel Alumel Type K                                                                         |
| 3.    | Type of Thermocouple            | Duplex with separate hot junctions, ungrounded Insulation Mineral Insulation Magnesium Oxide. |
| 4.    | Thermocouple wire gauge         | 16 AWG                                                                                        |
| 5.    | Protective sheath               | SS 321                                                                                        |
| 6.    | Protective sheath dia           | 8 mm O.D                                                                                      |
| 7.    | Characteristics of Thermocouple | Special limits of error as in ANSI thermocouple MC 96.01, 1975                                |
| 8.    | Mounting accessories            | 1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310             |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



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

**Notes:**

- 1) The specification for thermocouples of bearings metal and winding 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.
- 2) For boiler metal temperature applications considering the location of installation and response time, manufacturers standard and proven specification for metal temperature measurement can also be a accepted subject to OWNER approval. The manufactures shall submit adequate supporting documents for establishing their standard and proven practice.

**2.06.04 Thermo well (for all process temp. elements) - (As per ASME PTC 19.3, latest edition)**

- a. Shall be one piece solid bored type of 316 SS/F11/F22/F91 of step-less tapered design for water and steam Services depending upon process parameters.
- b. For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.
- c. For Air & Flue gas 316 SS protecting tube with welded cap. (However bidder shall provide better material for Flue gas service if required based on the specified boiler design parameters).
- d. For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.
- e. Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 (latest edition).

“All Thermowells in high velocity steam service shall be checked for Strouhal’s frequency limit to arrive at a safer size and design of Thermowells”.

**2.06.04** Void

**2.06.05 TEST THERMOWELLS (TW)**



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



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

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

## 2.07.00 TEMPERATURE TRANSMITTER

Following types of 2-wire temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the bidder as well as Owner. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

### a. Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP65.

### b. Single Input DIN-rail mounted Temperature Transmitter

These shall be suitable for mounting on DIN-rails in JB's. The specifications of the JB's shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail.

Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

### c. Dual-input Temperature Transmitter with Indicator:



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



These shall be suitable for mounting on pipes/ support. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails. This change-over is to be alarmed. Protection class shall be IP65 minimum.

The exact applications for which this type of transmitter is to be provided shall be finalized by owner during detailed engineering.

- d. Common requirements for each of the above type of temperature transmitters.
- |                               |   |                                                                                                                                                                                                                                                                                                   |
|-------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Output                        | : | 2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal.                                                                                                                                                                                |
| Input                         | : | Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K&R types (input type to be selectable at site through HART terminal)                                                                                                                                                      |
| Isolation                     | : | Min. 500 V AC                                                                                                                                                                                                                                                                                     |
| EMC compatibility             | : | as per EN 61326                                                                                                                                                                                                                                                                                   |
| Operating ambient temperature | : | 0 to 85 deg C (without indicator)<br>0 to 70 deg C (with indicator)                                                                                                                                                                                                                               |
| Power supply                  | : | Compatible with input module of Control System                                                                                                                                                                                                                                                    |
| Accessories                   | : | Mounting arrangements including Clamps etc.                                                                                                                                                                                                                                                       |
| Composite Accuracy            | : | (a) For head mounted and DIN-rail mounted type Refer note-2<br>RTD = <0.4% of 0-250 deg C span<br>T/C-K type = <0.4% of 0-600 deg C span<br>T/C-R type = <0.4% of 0-1000 deg C span<br><br>(b) For dual-input type:<br>RTD = <0.25% of 0-250 deg C span<br>T/C-K type = <0.2% of 0-600 deg C span |

- e. Field bus compatible temperature transmitters  
Temperature transmitters of this category shall be field mounting type & shall be capable of withstanding operating ambient temperature upto 85 deg C. These modules shall be connected to DDCMIS through field bus such as Profibus, Foundation Field bus etc directly from the transmitter. **Maximum Number of inputs per such temperature transmitter shall be eight.** These shall be mounted in cabinets in non-AC areas.



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



As an alternate, these signals from temperature transmitters can be connected to DDCMIS through standard remote I/O modules of the DCS, in which case, the temperature transmitter signals will be acquired through 4-20mA input modules in the remote I/O cabinet for connecting to DDCMIS through remote I/O bus.

**Notes (Common for a to e above):-**

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output.
2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.

**2.08.00 IMPACT HEAD TYPE FLOW ELEMENT**

The impact head type element shall be tubular insert type with four impact ports facing upstream direction, located precisely for determination of average flow velocity and shall be of SS 316 L.

Accuracy shall be 1.0% of actual value or better. Repeatability shall be  $\pm 0.1\%$  of actual value or better.

The elements shall be supplied complete with mounting hardware; end support plugs and SS316 valve manifold (1/2" NPT connection) for instrument connections. All pertinent data including Owner's instrument tag no. for the flow element shall be punched on a stainless steel plate and affixed to the element.

Flushing arrangement shall be provided.

Dual path transit time clamp-on Ultrasonic Flow meter may also be used for measurement of CW flow.

**2.09.00 FLUE GAS ANALYSER**

The following flue Gas analyzers are envisaged:-

- i) Flue Gas analyzers for control and monitoring – quantities as indicated in Vol. V, Appendix I, Sr. no. G1, Part A.
- ii) Flue Gas Dust Emission analyzer for each ESP (at each Path) – quantities as indicated in Vol. V, Appendix I, Sr. no. G1, Part A.



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



~~Each analyser shall be independent and shall not share power supply, processor etc. with other analyser except compressor for purging air. The common requirements to be met for all types of analysers are as below. The specific requirements to be met by each type of analyser are detailed in the subsequent clauses.~~

### 2.09.01 Common Requirements for all Analysers:-

| S.No. | Features                    | Essential/Minimum Requirements                                                                                                                                                                                      |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Output signals              |                                                                                                                                                                                                                     |
|       | Analog                      | 4-20 mA DC galvanically isolated. If analyser provides superimposed HART signal on 4-20 mA DC output, It shall also be connected to OWS/PC based station.                                                           |
|       | Binary                      | 2 NO + 2 NC for high alarm                                                                                                                                                                                          |
| 2     | Zero & span Adjustment      | To be provided with range selection facility.                                                                                                                                                                       |
| 3     | Ambient temp.               | 50°C                                                                                                                                                                                                                |
| 4     | Indication                  | Digital Alphanumeric Display. Display of reading in engineering units shall be provided.                                                                                                                            |
| 5     | Enclosure Type/Material     | Weather & Dust proof (IP 65) Die cast Aluminium/SS.                                                                                                                                                                 |
| 6     | Type of Electronics         | Microprocessor based with self diagnostic.                                                                                                                                                                          |
| 7     | Digital Signal transmission | HART/RS 485 Port Modbus Protocol/Ethernet TCP/IP protocol.                                                                                                                                                          |
| 8     | Calibration                 | Auto & Manual (from Remote)                                                                                                                                                                                         |
| 9     | Power Supply                | To be arranged by Bidder subject to Owner's approval.                                                                                                                                                               |
| 10.   | Others                      | I) All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to DDCMIS ( in central control room) & OWS/PC station are to be provided by Bidder. |
|       |                             | ii) All the calibration gases required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas.                                       |
| 11    | Location of probe           | High temp O2 –SH zone<br><br>Low temp O2:- ECO outlet, AH outlet and ID inlet.<br><br>Dust emission analyser – In each ESP gas stream/path                                                                          |
| 12    | Compliance to standards     | USEPA, TUV, MCERTS or equivalent standards                                                                                                                                                                          |
| 13    | Type of Technology          | Dust emission analyser – Opacity In situ (Path)type/ Tribo Electric Induction method In situ type<br>Low temp O2 & High temp O2-In situ type                                                                        |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



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

### 2.11.02 E-P CONVERTER

E-P converters and associated accessories shall be furnished in accordance with the specifications given below:

Air supply: 1.5 kg/cm sq., Input signal: 4-20mA dc (as required by the design of control system), Output signal: 0.2 to 1.0 kg/cm sq., Linearity: 0.5% of span or better, Hysteresis: 0.5% of span or better, Ambient Temperature Effect: less than 0.02% of span per deg C between -20 to +60 deg C. Mounting: Close to actuator (but not on the actuator), output capacity-to suit the actuator, protection class IP 65. On loss of control signal, the last set point pressure shall be maintained so that the associated control valve remains in stay put condition without any additional solenoid valve. The allowable drift rate will be +2% of set point/ hour maximum. Material of accessories will be SS. E/P converters shall have fail freeze (stay put) feature also. Zero/span adjustment facility shall be provided.

### 2.12.00 SPECIFICATION FOR FLOW ELEMENTS & FLOW METERS

#### 2.12.01 Orifice Plate

| Sr No. | Features                                       | Essential/Minimum Requirements                                                                                               |
|--------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| 1      | Features                                       | Essential/Minimum Requirements                                                                                               |
| 2      | Type                                           | Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167                                             |
| 3      | Material                                       | 316 SS                                                                                                                       |
| 4      | Thickness                                      | 3 mm for main pipe diameter up to 300 mm and 6 mm for main pipe dia above 300 mm.                                            |
| 5      | Material of branch pipe                        | Same as main pipe                                                                                                            |
| 6      | Root valve type                                | Globe                                                                                                                        |
| 7      | Root valve material                            | 316 SS                                                                                                                       |
| 8      | Root valve size                                | 1 / 2 inch or 1 inch (as applicable)                                                                                         |
| 9      | Impulse pipe of same material up to root valve | Required                                                                                                                     |
| 10     | Tapping                                        | Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable).<br><br>Root valves to be provided in all the tappings. |
| 11     | Beta Ratio                                     | 0.34 to 0.7                                                                                                                  |
| 12     | Beta Ratio                                     | Yes                                                                                                                          |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                     |                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                      | calculation to be submitted         |                                                     |
| <b>13</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | Assembly drg. and flow Vs DP Curves | Yes                                                 |
| <b>14</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | Accessories                         | Root valves, flanges, Vent/drain hole (As required) |
| Bidder shall submit certified flow calculation and differential pressure vs. flow curves for each element for Owner's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Owner's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of commutated flow calculations |                                     |                                                     |

### 2.12.02 Flow Nozzle

| Sr No.                                                                                                                                                                                                                                                                                                                                                                                                                               | Features                                       | Essential/Minimum Requirements                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-----------------------------------------------------------------------|
| <b>1.</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | Type                                           | Long radius, welded type as per ASME PTC- 19.5 (Part-III) or BS-1042  |
| <b>2</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | Material                                       | 316 SS                                                                |
| <b>3</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | Thickness                                      | Suitable for intended application.                                    |
| <b>4</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | Material of branch pipe                        | Same as main pipe                                                     |
| <b>5</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | Root valve type                                | Globe                                                                 |
| <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | Root valve material                            | 316 SS                                                                |
| <b>7</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | Root valve size                                | 1 inch                                                                |
| <b>8</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | Impulse pipe of same material up to root valve | Required                                                              |
| <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | Tappings                                       | Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). |
| <b>10</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | Beta Ratio                                     | Around 0.7                                                            |
| <b>11</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | Beta Ratio calculation to be submitted         | Yes                                                                   |
| <b>12</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | Assembly drg. and flow Vs DP Curves            | Yes                                                                   |
| <b>13</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | Accessories                                    | Root valves, vent and drain hole.                                     |
| Bidder shall submit certified flow calculation and differential pressure vs. flow curves for each element for Owner's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Owner's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of commutated flow calculations |                                                |                                                                       |

### 2.12.03 ROTAMETERS

| Sr No. | Features | Essential/Minimum Requirements |
|--------|----------|--------------------------------|
|--------|----------|--------------------------------|



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|   |                          |                                                                           |
|---|--------------------------|---------------------------------------------------------------------------|
| 1 | Type                     | Variable Area Metal Tube                                                  |
| 2 | Fluid media              | Water/oil                                                                 |
| 3 | Tube body                | SS316                                                                     |
| 4 | Material of float        | 316 SS                                                                    |
| 5 | Indicator                | Linear scale                                                              |
| 6 | Accessories              | Flange, orifice in case of bypass Rota meter (for line size above 100 mm) |
| 7 | Housing protection class | IP-65                                                                     |
| 8 | Accuracy                 | $\pm 2\%$ of measured value                                               |

#### 2.12.04 POSITIVE DISPLACEMENT TYPE FLOW TRANSMITTERS

The meter shall be a volumetric meter type consisting of two meshing oval wheels driven by the fluid. Each revolution of the oval wheels shall displace a precisely known volume of the fluid from inlet to outlet. The housing/measuring chamber and oval wheels shall be of 316 SS. Air eliminators shall also be provided to ensure maximum accuracy.

The measurement accuracy of the transmitter shall be better than  $\pm 0.2\%$ .

The transmitter shall provide suitable 4-20mA dc output signal for control and indication/recording. Converters if necessary shall be provided to generate the 4-20mA signal.

A local indicator of fuel oil flow shall also be provided. The instrument shall be calibrated in Tons/hr.

Suitable strainer shall be provided before the transmitter for the protection of oval wheel meters against foreign matter contained in the fuel oil.

The exact model no. and type of material being used, etc., shall be subject to Owner's approval during detailed engineering without any price repercussion to Owner.

#### 2.12.05 DUAL PATH TRANSIT TIME CLAMP-ON ULTRASONIC FLOW METER

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

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

Flow meters shall be provided with suitable environment protection devices/structures such that they shall be suitable for continuous operation in the



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



vii. Sewage Water Treatment Plant.

viii. ETP Misc. sumps with pumps.

18.04.01 Temperature measurement for winding of all HT drives shall be provided with 6 no. each duplex type RTDs or 12 no. simplex type RTDs. and 4 No. Duplex type RTD or 8 no. simplex type RTDS for bearing Temperature on both (DE & NDE) for each HT drive and Driven equipment.

Vibration measurement of all HT drives shall be as per details in Vol. V, part A and Part B, Chapter- 2

18.04.02 Power supply system required for Control and instrumentation system including parallel redundant (2 x 100%) UPS system, Batteries and 24 V DC chargers systems shall be provided as per Vol. V, Part A and Part B, chapter-7 for each system.

18.04.03 Bidder to provide all control equipment, instruments (As per Technical specification in Vol. V chapter-2 & 3), accessories and all Instrumentation cables (As per Technical Specifications mentioned in Vol. V, Part B, chapter-9) including laying and termination of cables, erection hardware for safe, efficient and reliable operation of the plant. (As per Technical specification in Vol. V, Part B, chapter-8 & 23)

18.04.04 Refer Vol. V, Part -A for detail control and operation of plant water system.

#### **18.04.05 DM WATER PLANT SYSTEM**

18.04.05.01 The operation and control of Dematerializing Plant shall be through plant water system DDCMIS with redundant hot standby processor. This plant water system DDCMIS shall have dual redundant bidirectional OPC link connectivity with Ethernet based TCP/IP protocol with main plant DDCMIS for monitoring purpose (as per DDCMIS format)

Three nos. Large Video Screen shall be provided for control and monitoring purpose.

However, there shall be provision of changeover to manual operation. The control operation philosophy shall include sequential control like semi-auto/remote-manual/manual, facility like step numbering, step time elapsed time, hold/release push button through work station, flow of control logic (sequence of various steps) for smooth operation of the entire plant.

Number of Operating Work Stations , operating cum Engineering Work stations , Type of Printers for Plant Water DDCMIS shall be as per Vol. V, Part -A along with its accessories like monitor ,keyboard etc.

18.04.05.02 DM plant control system shall be designed so that complete Operation, Control & monitoring, interlocks, logic etc. from D M Plant control room. Bidder shall also provide GIU and remote I/O panels as per requirements and as indicated in Vol. V, Part A.



- 18.04.05.03 The operator will initiate the operation of regeneration/rinsing/backwashing of a particular ion-exchange unit/filter based on the criteria described below, but the change from one step of the sequence to the next will be automatic. The system will employ a logical system, which will link the various steps such as closing/opening of different valves, starting/stopping of various pumps, which make a sequence.
- 18.04.05.04 Filters / Ion exchange units will be automatically isolated from the system as follows:
- a. Pressure Sand Filter: On passing predetermined volume of water or high Differential pressure across the filter bed.
  - b. Activated Carbon Filter: On passing predetermined volume of water or on reaching preset residual chlorine level of high Differential pressure across the filter bed.
  - c. Cation: On reaching high sodium leakage or on passing of predetermined volume of filtered water whichever Occurs first.
  - d. Anion Unit: On reaching higher conductivity & Silica at Outlet or on passing of predetermined volume of De cationised water, whichever occurs first.
  - e. Mixed Bed Unit: On reaching higher conductivity, pH at outlet or On passing of predetermined volume of deionised Water or on reaching preset silica level, whichever occurs first.
- 18.04.05.05 As state above, the isolation of the exchanger unit from the system will be displayed on monitor. The operator will then select the particular vessel to be regenerated through option and selected for regeneration. On selecting the option the regeneration cycle shall start automatically. During regeneration, the progress of different sequence/sub-process shall be displayed to the operator in the form of step number as well as step description which is in progress, the set time for that.
- 18.04.05.06 The progress of the sequence shall be displayed to the operator through suitable means. The system will incorporate the necessary safety systems, locking systems and manual emergency system. On failure of logic system, in between, the failure shall be annunciated to the operator and all the valves corresponding to that unit, being regenerated shall close automatically.
- 18.04.05.07 A graphic depicting the complete plant process operations shall be designed properly and be available on MONITOR. The graphic shall indicate the different filters, exchanger units, measuring tanks, opening/closing of valves (motorized and solenoid operated), ON / OFF of different pumps and blowers etc. Color-coding shall be used to differentiate lines for different services such as normal water lines, backwash lines, Acid / Alkali lines etc.
- 18.04.05.08 Separate conductivity measurement, silica measurement and pH measurements shall be employed for ensuring the various parameters in the effluent and in the rinse line of caution, anion and mixed bed exchanger units for normal and rinsing operation (As per the technical specification mentioned in Vol-III). The



conductivity cell in the rinsing line shall be automatically isolated during the first half of the rinsing cycle and shall be connected automatically during the second half of rinsing cycle when the conductivity is less than 100 micromhos/cm excess over the rinse water conductivity.

- 18.04.05.09 Discharge valves of all pumps of the entire plant, connected with semi-auto/remote manual operation shall be pneumatically operated: and all pumps, pneumatically operated valves, drive motors of all the other equipment and other accessories, pneumatic on-off valves, etc. shall be completely suitable for remote manual operation from operating console/panel. All drive motor shall also be provided with arrangement of local stopping. Tripping of drive motors from local panel shall be permissible irrespective of the position of local-remote selection option. Local stop push-button shall be locked after tripping the motor from local.
- 18.04.06 Although the basic demineralising process is semi-automatic in nature, following operations shall be performed manually.
- 18.04.06.01 Unloading and Transfer of Acid.
- i. Hydrochloric acid will be unloaded from the road tank-cars by operating any one of the acid unloading pumps. Operation shall be controlled from local panel.
  - ii. Hydrochloric acid, stored in over ground tanks, will be led remote manually by gravity to the acid measuring tanks for cation, mixed bed units to fill up to the desired level. Subsequent transfer of acid from the measuring tanks to the ion-exchanger units as required in regeneration operation is however automatic.
- 18.04.06.02 Unloading, Preparation and Transfer of Alkali.
- i. Caustic solution will be unloaded from the road tank-cars by operating any one of the Caustic unloading pumps. Operation shall be controlled manually from local panel.
  - ii. Caustic solution, stored in over ground tanks, will be led remote manually by gravity to the caustic measuring tanks for anion, mixed bed units to fill up to the desired level. Subsequent transfer of caustic from the measuring tanks to the ion-exchanger units as required in regeneration operation is however automatic.
  - iii. All operations in items (a) and (b) will be controlled manually from the local panel.
  - iv. Transfer of alkali to the respective measuring tanks for anion and mixed bed exchanger units will be done remote manually. However, subsequent transfer of alkali to respective ion exchanger units will be automatic.
- 18.04.06.03 Neutralization of Waste from DM Plant.
- i. After completion of regeneration of one cation and one anion exchanger, the waste generated during regenerations will be thoroughly recirculated



in the neutralizing pit and if necessary, acid/alkali solution will be added to make the waste slightly alkaline.

- ii. When required pH of waste solution has been reached, the waste solution will be pumped to the effluent treatment plant area and the effluent shall conform to IS-2490. The pump will automatically be tripped when the level in neutralization pit reaches very low.
- iii. Priming of pumps operating under suction lift and operations as in (a) and (b) will be done manually. All pump operation shall be controlled from the local panel.

#### **18.04.07 PRE TREATMENT PLANT**

The operation and control of PT plant shall also be done through plant water system DDCMIS with Redundant hot standby processors.

The control operation philosophy shall include sequential control like semi-auto/remote-manual/manual, facility like step numbering, step time elapsed time, hold/release push button through work station, flow of control logic (sequence of various steps) for smooth operation of the entire plant.

The Operating stations and Engineering stations, printers etc. for control and operation of plant water system DDCMIS shall be provided as per Vol. V, part -A along with its accessories like monitor, keyboard etc.

- 18.04.07.01 The chemical dosing is envisaged only in manual mode from local. The Dosing pumps, Tank agitator, Sludge pumps and clarifloculator bridge pumps shall be operated from remote as well as local control panel of chemical house.
- 18.04.07.02 Drives on the clarifier bridge i.e. rake mechanism drive motor and flocculator agitator motor shall be operated from local start/stop push buttons to be located near it.
- 18.04.07.03 The clarified water storage sump level is controlled by raw water inlet control valve with respect to the level in the clarified water sump.
- 18.04.07.04 All the chemical dosing/solution tank shall be provided with local level indicator and low level switch, which shall be interlocked with respective dosing pumps i.e. the pump shall trip in case of the low level in the respective tank.
- 18.04.07.05 The sludge sump shall be provided with necessary Level switches which shall be used for Auto start /stop of Sludge pumps.
- 18.04.07.06 Bidder shall provide flow transmitter/meter to measure total Raw Water flow for indication totalisation in plant water system DDCMIS..

#### **18.04.08 Sewage water TREATMENT PLANT**

The operation and control philosophy of sewage water Treatment Plant shall be done through Relay based control system. Relay based control desk shall be provided with coloured Mimic, H.W. Annunciator, P.B., Indicators, indication Lamps and Ammeters )



Hysteresis : Less than  $\pm 1\%$  of full travel.

**2.16.00 WATER SYSTEM RELATED SPECIAL INSTRUMENTS (CW plant, D M PLANT, CPU PLANT, PT PLANT, AWRS, Service water, Potable water, etc.)**

**2.16.01 ANALYSER INSTRUMENTS:**

For Technical specification of Cation/Specific Conductivity, pH, Sodium, Silica, Turbidity, Total Dissolved Solids (TDS) and Concentration analysers, and other requirements, please refer Specification of Analysers, Vol.-V, Part A and Part-B, chapter 5, SWAS chapter of this specification.

**2.16.02 Residual Chlorine Analyser**

- (a) An automatic chlorine residual analyser of amperometric type shall be provided alongwith the chlorinating plant for monitoring the residual chlorine content of cooling water. The analyser shall be suitable for accurate residual measurement in open/closed systems. The measurement accuracy shall not be affected by presence of treatment chemicals as chromates, phosphates, de-former highly polluted water, change in temperature etc.
- (b) The analyser shall comply with the following specification requirements, as a minimum
- (i) Indicator : Provision of LC display in the panel of analyser.
  - (ii) Range : 0 to 20.0 mg/L (ppm)
  - (iii) Accuracy : 2% or better
  - (iv) Sensitivity : 0.01 mg/1
  - (v) Output signal : 4-20mA DC isolated output
  - (vi) Alarm annunciation : High and low alarms to be provided on panel and shall be field adjustable
  - (vii) Calibration : Zero and span adjustment facility to be provided. Final calibration adjustments of the analyser to be done at site and duly verified by titration. Temperature compensation range 0 to 50degC.
  - (viii) Mounting : The analyser shall be suitable for field mounting conform to protection class IP-65.
  - (ix) Electrodes : Platinum/Gold and copper electrodes shall be provided with cell cleaning system.
  - (x) Power Supply : 230 V AC, +/- 10%, 50 Hz. From UPS
- (c) Circulating water as sample to residual chlorine analyser shall be taken from hot circulating water pipe work before entry to cooling towers. Exact location and layout of sampling arrangement shall be finalised during detailed engg. stage. Bidder shall provide necessary pumping system (with 100% standby) for meeting the analyser requirements, if needed. All the



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



drains shall be terminated up to the nearest plant drainage system.

**2.16.03** All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipments are protected against rain/ sunlight etc.

**2.16.04 Parshall Flume**

The Bidder shall provide all the control and Instrument devices including primary sensors, transmitters, flow indicator cum integrator / totaliser and shall include all required accessories for the flow measurement of raw water through the clarifier. The system shall be of reputed make and acceptable to the owner.

Level measurement shall be based on ultrasonic/radon technology. The flow compensation is to be implemented in the transmitter itself. The transmitter shall provide 4-20 mA DC in direct proportion to flow and shall be able to drive a load impedance of 500 ohms minimum

Accuracy shall be +/- 1 % or better.

All the mounting hardware and accessories required for erection and commissioning of the same are to be provided by the bidder. Mounting fittings material shall be SS316. All weather canopy is to be provided for electronics/sensor to protect the same from rain/ sunlight etc.

The Type makes and models no. shall be subject to Owner's approval.

**2.16.05 Electronic Flow-Meter**

The electronic flow meter shall include flow sensor and flow indicator cum integrator / totaliser and shall include all required accessories for satisfactory operation. The flow meter shall be based on full bore ultrasonic / electromagnetic principle and shall be electronic type of proven design, make and model acceptable to the owner.

The Bidder shall submit all necessary technical literature and details of selection criteria of the instrument offered to substantiate the model selected. The Bidder shall also furnish list of similar installation along with feed back on satisfactory performance of the instruments.

The flow meter shall meet or exceed the following requirement:

|     |                 |                                            |
|-----|-----------------|--------------------------------------------|
| (a) | Output          | 4-20 mA DC Isolated output HART compatible |
| (b) | Accuracy        | ± 0.5% of calibrated span or better *      |
| (c) | Repeatability   | ± 0.2% of calibrated span or better        |
| (d) | Ambient Temp. & | 4 deg.C to 55 deg.C.                       |
|     | Humidity        | 5% to 100% RH                              |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



|     |                                                      |                                                                                                                        |
|-----|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| (e) | Power Supply                                         | UPS 240V AC $\pm$ 10%, 50 HZ $\pm$ 5%/ 24 V DC, to be arranged by the bidder.                                          |
| (f) | Protection class                                     | IP-65                                                                                                                  |
| (g) | flange material, Measuring tube & electrode material | SS 316                                                                                                                 |
| (h) | Liner material.                                      | Teflon.                                                                                                                |
| (i) | Features                                             | zero stability, zero and span field adjustable, suitable for process medium with $\leq$ 5 micron Siemens conductivity. |

The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totaliser / integrator to get the daily and monthly discharge as stated above.

### 2.16.06 REVERSE ROTATION INDICATOR (RRI)

For each of CW pumps & ACW pumps, a reverse rotation indicator comprising of proximity sensors, processing electronics with output of 4-20mA (corresponding to speed) interconnecting cables, speed display in rpm, normal, reverse indication and required channel alarm contact shall be provided. The contact rating shall be 60 VDC, 6VA (or more if required by Control system). The exact details of the RRI shall be strictly as approved by Owner during detailed engineering. The power supply of RRI is to be arranged by the Bidder from UPS.

### 2.16.07 ~~Non - Nucleonic (Vibration) Type Density Meter (For DM & AHP Plant):-~~

Application : Liquid Density measurement

#### **Detector**

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

#### **Convertor**

1. Output : 4-20 mA DC isolated.
2. Electrical Connection : 1/2" NPT
3. Enclosure Class : IP 65
4. Local Display : Digital 5 digit, density display with temp. compensation.
5. Accuracy : +/- 1%
6. Response time : < 1 minute.
7. Power Supply : 230 V AC, +/- 10%, 50 Hz. From



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



## UPS

**2.16.08 FLOAT & BOARD TYPE LEVEL GAUGE**

|                                                  |   |                                                                                                                                                                                                                                                                       |
|--------------------------------------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type of Instrument                               | : | Mechanical Type (Float Operated)                                                                                                                                                                                                                                      |
| Service/ Application                             | : | As per service requirement                                                                                                                                                                                                                                            |
| Measuring Range                                  | : | As per requirement                                                                                                                                                                                                                                                    |
| Material Specification                           |   |                                                                                                                                                                                                                                                                       |
| a) Float Material                                | : | SS316 having 2 nos. Guide wires                                                                                                                                                                                                                                       |
| b) Float Wire Pulley                             | : | Shall comprise of 2 nos. Cast Aluminum Pulley housing Assembly with SS 304 pulley and pulley shaft. Steel ball bearings shall be provided in pulley housing for easier float movement. Float wire material shall be SS316L. Between 2 pulleys, 1" NB G.I. short pipe. |
| c) Guide wire Assembly                           | : | CS chamber with spring and adjuster having 1" Class 150 ANSI RF MS flange. Guide wire rope shall be SS316L.                                                                                                                                                           |
| d) Counter Weight                                | : | MS counter – weight with Aluminum Pointer and Brass assembly Pull Chain.                                                                                                                                                                                              |
| e) Scale details                                 | : | Aluminum/SS316 scale Graduated in mm with 1% accuracy of full scale range with arrow.                                                                                                                                                                                 |
| Nozzle Details                                   | : | For float wire pulley assembly, one tapping and for guide wire assembly two tapping at the top of the tank; Size 1" NB (Top Mounting Type).                                                                                                                           |
| Process Connection                               | : | Flanged as per ANSI B 16.5 to suit 1" NB nozzle                                                                                                                                                                                                                       |
|                                                  |   | (Nozzle length - 150 mm for float wire, 100 mm for guide wire)                                                                                                                                                                                                        |
| Accessories (to be supplied with the instrument) |   |                                                                                                                                                                                                                                                                       |
| a) Counter flange                                | : | All mating Flanges, Nozzle                                                                                                                                                                                                                                            |
| b) Mounting Accessories                          | : | All mounting accessories                                                                                                                                                                                                                                              |
| c) Tag Plate                                     | : | To be provided (material SS316)                                                                                                                                                                                                                                       |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



Location : Field (Direct Mounting)

## **2.17.00 AC PLANT AND COMPRESSOR RELATED SPECIAL INSTRUMENTS**

### **2.17.01 (HUMIDITY SENSOR)**

Sensor : Capacitance type  
Accuracy : +/-3% R.H  
Range : 0-100% R.H  
Output : 4-20 ma  
Time constant: 2 mins.

Output from the sensor is to be connected to respective control system. Bidder can also provide combined instrument for measurement of humidity and temperature subject to Owner's approval during detailed engineering. In all such cases, 4-20 ma outputs, each for temperature and humidity measurements are to be provided.

### **2.17.02 TEMPERATURE/ HUMIDITY INDICATOR**

Sensor : RTD for (Pt 100) for temperature  
: Capacitance Type for Humidity (specs for humidity and temperature shall be as mentioned above)  
Display : Combined enclosure with two three digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of at least 10 meters.  
Range : 0-60 Deg C for temperature.  
: 0-95.0 % for Relative Humidity.  
Accuracy : Better than +/-0.5 % for Temperature  
: Better than +/-2.5 % for Relative Humidity  
Mounting : Table Top/ wall mounting.  
Power supply : 240 V AC, 50 Hz.  
Output : 4-20 mA signal each for temperature.  
Qty. : 15 nos. each of temperature & Humidity indicators (combined indicators for Humidity and temperature is also applicable).

One Set of output signal is to be connected to respective control system. Apart from displaying the temperature/humidity values on indicator.

### **2.17.03 DEW POINT METER**

Type : 2 Wire Loop Powered Dew point  
Transmitter



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



**DCPL**

**Volume V**  
Instrumentation & Control Works

**Part B/Ch 2: Field &  
Measuring Instruments**  
Sheet | 40 of 56

|     |                                                      |                                                                                                                        |
|-----|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| (e) | Power Supply                                         | UPS 240V AC $\pm$ 10%, 50 HZ $\pm$ 5%/ 24 V DC, to be arranged by the bidder.                                          |
| (f) | Protection class                                     | IP-65                                                                                                                  |
| (g) | flange material, Measuring tube & electrode material | SS 316                                                                                                                 |
| (h) | Liner material.                                      | Teflon.                                                                                                                |
| (i) | Features                                             | zero stability, zero and span field adjustable, suitable for process medium with $\leq$ 5 micron Siemens conductivity. |

The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totaliser / integrator to get the daily and monthly discharge as stated above.

### 2.16.06 REVERSE ROTATION INDICATOR (RRI)

For each of CW pumps & ACW pumps, a reverse rotation indicator comprising of proximity sensors, processing electronics with output of 4-20mA (corresponding to speed) interconnecting cables, speed display in rpm, normal, reverse indication and required channel alarm contact shall be provided. The contact rating shall be 60 VDC, 6VA (or more if required by Control system). The exact details of the RRI shall be strictly as approved by Owner during detailed engineering. The power supply of RRI is to be arranged by the Bidder from UPS.

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

Application : Liquid Density measurement

#### Detector

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

#### Convertor

- |    |                       |   |                                                           |
|----|-----------------------|---|-----------------------------------------------------------|
| 1. | Output                | : | 4-20 mA DC isolated.                                      |
| 2. | Electrical Connection | : | 1/2" NPT                                                  |
| 3. | Enclosure Class       | : | IP 65                                                     |
| 4. | Local Display         | : | Digital 5 digit, density display with temp. compensation. |
| 5. | Accuracy              | : | +/- 1%                                                    |
| 6. | Response time         | : | < 1 minute.                                               |
| 7. | Power Supply          | : | 230 V AC, +/- 10%, 50 Hz. From                            |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



provided with a phenolic name plate engraved with a legend acceptable to the owner.

### 5.03.10 Grab samples

Grab samples valves on the front of SWAS panel shall be provided to direct grab samples to tough through grab sample nozzles or to the drain header. Approximately 300mm of flexible tubing shall be provided for each sample to allow grab sample collection and prevent splashing. Grab sample nozzles shall be provided with adapter and panel mounting flanges. All these items i.e. nozzles, adapter and flanges shall be owner approved make.

### 5.03.11 Sample Sink

A continuous sink, located at the place of grab sample analysis, shall be provided. The sink shall be SS 316, 14 gauge minimum. The sample sink shall be connected to waste drain header. Sample sink shall contain an integral SS ledge to accommodate sample container. DM water connection shall be provided for cleaning of sample containers.

## 5.04.00 SPECIFICATION OF ANALYSERS

Field proven reputed international make microprocessor based monitors/analysers with LCD/TFT display and with necessary fault diagnostic features shall be employed. All analysers shall provide 4-20 mA output signal capable of driving a load impedance of 500 Ohms minimum. The type, size, capacity, material, make, model and other specification details of the rest of the SWAS system like coolers, gauges/switches, sample pipes, filter, pressure reducing elements, grab sampling arrangement, valves & fittings, panels etc shall be as decided during detailed Engineering stage in line with technical specification and shall be subject to owner's approval. The power supply to all analysers/monitors shall be supplied by bidder from plant UPS system with redundant feeders & auto changeover, all necessary switches, 2 Pole MCB, fuses, wiring/cabling and other required accessories etc for distribution to individual requirements.

### 5.04.01 Minimum specification of Analyzers:

| Measurement                             | Type                                                                        | Accuracy       | Response time (90% of full scale) |
|-----------------------------------------|-----------------------------------------------------------------------------|----------------|-----------------------------------|
| <b>Conductivity/ TDS/ Concentration</b> | Continuous flow through type                                                | $\leq \pm 1\%$ | $\leq 5$ Sec                      |
| <b>pH</b>                               | Cell flow through sample                                                    | $\leq \pm 1\%$ | $\leq 5$ Sec                      |
| <b>Chloride</b>                         | Continuous flow through type with chloride & sulphate responsive electrodes | $\leq \pm 5\%$ | $\leq 5$ Min                      |

|                  |                                                                                                                      |                                                              |               |
|------------------|----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|---------------|
| <b>Turbidity</b> | Light reflection principle                                                                                           | $\leq \pm 2\%$ for 0-50 NTU<br>$\leq \pm 5\%$ for 50-200 NTU | $\leq 5$ Min  |
| <b>Hydrazine</b> | Automatic continuous electrochemical type                                                                            | $\leq +/ -5\%$                                               | $\leq 3$ Min  |
| <b>Si</b>        | Continuous colorimetric type                                                                                         | $\leq +/ -5\%$                                               | $\leq 15$ min |
| <b>Na</b>        | Continuous flow through type with sodium responsive electrode and reference electrode having pH adjustment facility. | $\leq +/ -10\%$                                              | $\leq 4$ Min  |
| <b>DO2</b>       | Continuous flow through type                                                                                         | $\leq +/ -5\%$                                               | $\leq 30$ Sec |

The measuring range for the above analysers shall be suitable for the process requirement. Automatic temperature compensation shall be provided for all the analysers.

All the analysers/cells shall have open corrosion resistant drain to waste header.

Dual Cation exchange column shall be provided for cation conductivity.

Conductivity analyser shall be provided with automatic ammonia (NH<sub>3</sub>) removal facility.

Silica Analyser shall be provided with auto reagent shut off solenoid valve feature (in case of sample loss or power loss) and built in phosphate inhibition feature.

Hydrazine Analyser shall be provided with auto reagent shut off solenoid valve feature (in case of sample loss or power loss).

For Hot well conductivity measurement, direct insertion/withdrawal type conductivity cells shall be provided, whereas for all other samples it shall be flow through type. Monitors for hot well conductivity shall be suitable for field mounting.

Make of complete assembly including sensor, analyser & monitor shall be same.

5.04.02 The sample points and the type of measurement for each sample shall be as per, Appendix-I to Part-A, Vol. V of technical specification.

5.04.03 All analysers shall be supplied with chemicals/reagents required for 12 months operation in phased manner depending on shelf life, in addition to that indicated under mandatory spares. Bidder shall also provide start up kits, buffer solution for pH and conductivity analyzer. The analyser supplier shall submit the preparation procedure / formula of the reagent to be used in analyser solution.

## 5.05.00

## SAMPLE PIPING SYSTEM



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



| Application                                                                                                   | Piping material       |
|---------------------------------------------------------------------------------------------------------------|-----------------------|
| Sample tapping point to primary cooler (including root valves and fittings)                                   | As per process pipes. |
| All the sample pipe after primary cooler                                                                      | ASTM A213 TP316H      |
| Blow down header and misc. drain receiver holder                                                              | ASTM A312 Type 304    |
| Closed CW piping except grab sample and water purge line, sample through drain piping and waste header piping | ASTM A53 Gr. A        |
| Purge air piping/ tubing and fitting valves                                                                   | Brass/ Copper         |

Size and Schedule number of sample pipes shall be suitable for particular application. Pressure reducing valves, Isolation valves before the primary sample cooler and all the isolation valves for pressure and flow indicators shall be needle valves. Cooling water and chilled water supply and return valves shall be block valves.

All sample piping shall be ¾"NB seamless type of material ASTM A213 TP 316H, conforming to ANSI B36.19. The schedule number shall be suitable for the particular application.

All fittings shall be socket welded type and of material ASTM A182 F316H confirming to ANSI B16.11.

The valves to be used in sample piping shall be of globe type, forged construction and stainless steel confirming to ASTM A182 with pressure and temperature ratings as per ANSI B16.34. The valve design shall be such that the seats can be reconditioned and stem and disc can be replaced without removing valve body from the line.

All the components, piping, tubing, fittings, valves, filters and other wetted parts in the sampling and analyzing system shall be designed to handle the over range of One Fifty (150) percent of operating process parameters.

All materials, furnished shall conform to the latest editions of America National Standard Code for Pressure piping, Power piping, ANSI B31.1, ANSI B16.11, ASME Boiler and Pressure Vessel Codes, IBR and other applicable ASME, ANSI and Indian Standards. Schedule numbers, sizes and dimensions of all carbon steel, stainless steel and alloy seamless steel pipe shall confirm to ANSI B.36.10 and of stainless steel pipe shall confirm to ANSI B 36.19 unless otherwise specified.



DCPL

**Volume V :**  
Instrumentation & Control Works

**Part B/Ch. 9–Instrumentation  
Cables**

Sheet | 23 of 30

- ~~Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.~~
- 9.07.02 Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.
- 9.07.05 The Bidder shall be responsible for proper grounding of all equipment under this package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests.
- 9.07.06 The Bidder shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Bidder.

**9.08.00 Field Mounted Local Junction Boxes**

|                   |   |                                                                                                                                                                                                 |
|-------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type of Enclosure | : | Flame proof/weather proof IP-65 /Explosion Proof as per area classification. Design as per NEC-370 Article 18, 19 & 20.                                                                         |
| No. of Ways       | : | 12/24/36/48/64/72/96/128 with 20% spares terminals.                                                                                                                                             |
| Material          | : | 4 mm min. thick FRP (Fiberglass Reinforced Polyester) with protective Coating                                                                                                                   |
| Cable entry       | : | 3 mm min. thickness Die cast aluminum for Flame proof/Explosion proof area.                                                                                                                     |
| Cable glands      | : | Bottom or Side                                                                                                                                                                                  |
| Mounting          | : | Double compression type – Nickel plated Brass/SS316 with PVC hoods.                                                                                                                             |
| No. of terminals  | : | Indoor/Outdoor                                                                                                                                                                                  |
| Terminals         | : | As required with standardization with 20% spare of each size & type.                                                                                                                            |
| Grounding         | : | Phoenix/Wago (screw less rail mounted cage clamp type spring loaded suitable for conductor size up to 2.5 sq. mm)                                                                               |
| Door              | : | Two terminals for body and shield ground                                                                                                                                                        |
| Accessories       | : | Hinged, lockable type.                                                                                                                                                                          |
|                   | : | Suitable mounting clamps and other accessories shall be in scope of bidder.                                                                                                                     |
|                   | : | The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of SS304, included in bidder scope of supply. High voltage & insulation resistance test shall also be conducted. |



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.)

Gasket (Normal)- Neoprene/Polyurethane thickness 6.0 mm. Silicon for high Temp. area.

Colour : To be decided during detailed engineering & subject to owner's approval.

### **9.09.00 Conduits**

Conduits shall be generally used for interconnecting cables from field instruments to local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS:9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant lead coated galvanised steel with, water leak, fire and rust proof protected for the areas of Mills, Drum, Main steam, RH steam Air Heaters and Furnace, BFPDT's.

And for remaining application, water leak, fire and rust proof flexible GI conduits shall be provided. The temperature rating of flexible conduit shall be suitable for actual application.

The Bidder shall install conduits according to the general routing as approved by owner and shall coordinate conduit locations with other works.

All grounding bushings within all enclosures shall be wired together and connected internally to the enclosure grounding lug or grounding bus with 8 AWG bare copper conductors. Conduit runs to individually mounted equipment shall be grounded to the Owner's cable tray grounding conductor with 12 AWG bare copper conductor. All grounding bushing, clamps, and connectors shall be subject to approval of the owner.

All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanised steel fittings shall be used with steel conduits. All flexible conduit fittings shall be liquid tight, galvanised steel. The end fittings shall be compatible with flexible conduit supplied.

All individually mounted equipment and devices shall be connected to the supply conduit, using not more than one meter of flexible conduit adjacent to the equipment or device. Flexible conduit shall be installed in all conduit runs, which are supported by both building steel and structures subject to vibration or thermal expansion. This shall include locations where conduit supported by building steel enters or becomes supported by the turbine generator foundation and where conduit supported by building steel or foundation becomes supported by steam generator framing.

Special areas, such as control rooms in which external noise is to be minimized, shall have flexible conduit in conduit runs where the runs cross from the main Building framing to the control room framing.