

**UPRVUNL**

**1X660 MW PANKI TPS EXTENSION**

**TECHNICAL SPECIFICATION  
FOR  
SUMP PUMPS**

**Specification No.: PE-TS-426-100-N002 (Rev-00)**



**BHARAT HEAVY ELECTRICALS LIMITED  
POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NOIDA-201301**



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**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**

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**Notes:**

***1) In case there is conflict in different clauses of specification, most stringent clause (as decided by BHEL / end customer) shall be followed, if no specific deviation is taken by bidder and accepted by BHEL during tender stage in that regard.***



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## **SECTION - I**

### **SPECIFIC TECHNICAL REQUIREMENTS**

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**SUB-SECTION – IA**

**SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)**





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### 1.0 SCOPE:

This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and/or his sub-contractors works, proper packing for delivery and mandatory spares (if applicable) complete with all accessories as per the requirements specified in this specification and any other services, etc. if called for in the succeeding sections of the specification.

#### 1X660 MW PANKI TPS EXTENSION

Evaluation of sump pumps as indicated in technical specification shall be as per NIT.

#### Note:

- a) The bidder shall include complete supplies for the project in his scope, part supplies offered for project shall disqualify the offer.
- b) Sump pumps details viz. quantity, Capacity, Head, Materials of construction, Mandatory spares and other particulars are detailed in Data Sheet-A at Section-ID of the specification.

### 2.0 SCOPE OF SUPPLY:

**2.1.1** Scope of supply includes Pumps, motors with standard/special accessories which shall necessarily be the part of the pump bidder scope.

**2.1.2** The pumps shall be complete with following standard/ special accessories- as applicable.

#### **2.2.1 Standard accessories to be supplied with each pump.**

- a) Electric motor drive with cable glands.
- b) Self-contained lubrication system.
- c) Erection & commissioning spares, as required.
- d) Supply of first fill of lubricants including second fill/ replenishment as necessary after commissioning and handing over of equipment.

#### **2.2.2 Special accessories included in Bidder's scope of supply:**

The following accessories besides those stipulated in Data Sheet-A shall be in bidder's scope.

#### **a). For TYPE A (Fixed Duty Submersible Sump Pumps):**

The following to be included in pump bidder scope.

- One No. wall mounted local control panel for each set of two (2) Nos. of submersible sump pumps. The LCP shall also house starter panel of submersible sump pumps. For details of panels and control interlocks- refer Clause No. 7.1 in succeeding paras of this Section. Control system for projects shall be relay based.
- Submersible type power & control cable for each pump of lengths as per data sheet A of respective project with suitable connection arrangement to wall mounted starter cum control panel. Separate Cables shall be provided by Bidder for power and control purpose and these cables shall not be bunched together. Minimum size of power cables shall not be less than 2.5 mm square. Cable shall be flexible copper conductor PVC insulated, armored and overall hard grade PVC sheathed. In case where power and control cables are combined, the paired screened cable shall be provided.



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- One (1) no. Delivery bend shall be provided with necessary Counter Flanges with Nuts, Bolts, Gaskets etc. with each pump.
- One (1) no. 30m long discharge hose (canvas) having female hose coupling at both ends & of size to suit pump discharge shall be provided for each pump. Arrangement of connecting hose with pump discharge and connecting with discharge pipe works of purchaser shall be as per clause no. 2.2.4 below.
- 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 Delivery bend and connected therewith by necessary bolts, nuts & gaskets.
- One (1) no. 30 meters long submersible type power cable with a hermetically sealed (waterproof) cable gland for connection with the pump drive- motor.
- Skirt base with suction strainer as applicable.
- 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 with chain (Chain length: 15 M).
- One no. Wall Mounted Common Relay based control panel for each set of 2 Nos. (two) pumps with integral starter and other features as detailed in C&I Specification.
- 3 Nos. Level switches as per control interlock requirement as detailed in Clause No. 7.1 herein.
- Other accessories as mentioned in Datasheet-A.
- Any other standard accessory required for safe and trouble free operation of Pumps to be provided by Bidder.

**b). For TYPE B (Portable Trolley mounted Horizontal Centrifugal Sump Pumps):**

The following to be included in pump bidder scope.

- Pump flange and Counter Flanges with Nuts, Bolts, Gaskets etc.
- One (1) no. 7.5 m long suction hose and One (1) no. 30m long discharge hose to be considered so that the sump pump can be discharged to the nearest surface drain. The size of discharge piping shall be to suit pump discharge. Either ends of each hose being provided with female hose coupling.
- One (1) no. 500 mm long straight pipe piece with both ends flanged, one end matching with the pump suction nozzle.
- 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 m 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 m long hose on the other side. The pump suction pipe-piece and discharge nozzle shall be of flanged type and shall be equipped with necessary bolts, nuts & gaskets.
- 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.
- A starter panel complete with incoming switch/contactors, fuse, overload relays, start-stop push button, O/L reset push button, cable gland, wiring terminals, red and green indication lamps (LED type) 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



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panel. Power Supply requirement to Starter Panels etc. shall be through 2P MCBs.  
(For Motor Driven Pumps Set only)

- A suitable trolley with swivelling front wheel and having adequate fixing arrangement for pump motor/diesel engine set with a base frame along with all above accessories, for operation without any undue vibration and with facility for being handled by a single operator.
- Accessories as per data sheet.
- Noise level shall be less than 85 dB at 1 meter.
- Any other standard accessory required for safe and trouble free operation of Pumps to be provided by Bidder.

**c). For TYPE C (Portable trolley mounted Submersible type sump pumps):**

For these pumps 63 amps. Welding socket shall be made available by BHEL for power supply. The following shall be included in pump bidder scope:

- Wheel trolley for carrying pump and drive unit along with starter cum control panel. Trolley shall have swiveling front wheel and have adequate fixing arrangement for pump motor set with a base frame along with all below accessories, for operation without any undue vibration and with facility for being handled by a single operator.

The trolley shall be provided with "Hose Reeling Drum" & "Cable Reeling Drum".

The pump motors set shall be suitably mounted on trolley with solid rubber type wheels, the trolley shall be of robust construction. The portable pump with its drives shall be secured to the trolley such that there is no unbalance when the trolley is moved from one location to another or when the pump is working. The number of wheel trolleys shall be one (1) per pump.

- One Trolley Mounted starter panel, having a plug socket as receptacle of the above mentioned power plug (item "d"), a 50-meter-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. Power Supply requirement to Starter Panels etc. shall be through 2P MCBs. The starter cum control panel shall be suitable for outdoor duty and to be provided with protection canopy.

Control system shall be relay based.

- Power cable connected to starter panel at one end and with plug compatible to 63 amp. Socket at the other end (Details shall be furnished during contract stage.) for connecting purchaser's power supply to starter panel.
- Hose pipe with hose nipple, flanges, nuts and bolts & matching counter-flange with nuts, bolts and gaskets for connecting with pump discharge at one end & discharge pipe works of purchaser at other end. Arrangement of connecting hose with pump discharge and connecting with discharge pipe works of purchaser shall be as per clause no. 2.2.4 below.
- One (1) no. 500 mm long pipe piece with both end flanged, one end connected by necessary bolts, nuts & gaskets with the flanged discharge nozzle of the sump pumps.
- Two (2) nos. 30m long discharge hose (canvas) having female hose coupling at both ends & of size to suit pump discharge shall be provided for each pump.
- 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 piece end and connected therewith by necessary bolts, nuts & gaskets.
- One (1) no. 30 meters long submersible type power cable with a hermetically sealed



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(waterproof) cable gland for connection with the pump drive- motor.

- Cables for connecting the starter panel with the nearest power supply source (cable length – 25M)
- Skirt base with suction strainer as applicable.
- 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 with chain (Chain length: 15 M).
- Level switches as per control interlock requirement as detailed in Clause No. 7.2 herein.
- Other accessories as mentioned in Datasheet-A.
- Any other standard accessory required for safe and trouble free operation of Pumps to be provided by Bidder.

**2.2.3** Rust inhibitor paint at Manufacturer's works.

**2.2.4** Arrangement of connecting hose with pump discharge & discharge pipe of purchaser (if required).

One end of the discharge flange of the pump shall be connected to the delivery bend of suitable size.

Suitable sized expander/ reducer if required shall be connected with necessary flanges at both ends (bidder scope).

In case expander / reducer is not required, delivery bend shall be connected with hose nipple. Hose pipe shall be connected to hose nipple with necessary clamping arrangement.

In case expander / reducer is required, flange connected with hose nipple shall be connected to reducer / expander. Hose pipe shall be connected to hose nipple with necessary clamping arrangement.

The other end of hose to be connected to pipe work of purchaser shall be provided with suitable flanged piece with counter flanges, nuts and bolts.

**2.2.5** One set of special tools & tackles for maintenance of equipment for each project shall be in bidder's scope.

**2.2.6** Bidder shall provide various drawings, data, calculations, test reports/ certificates operation & maintenance manuals including As Built drawings, etc. as specified and as necessary for the project.

**3.0** Works excluded from Bidder's scope. The following/ services shall be provided by purchaser.

- a) Civil foundation
- b) Power supply

**4.0** The pumps will be subjected to mechanical running at works and site by the purchaser. If the site performance is found not meeting the requirements including vibration and noise as specified, then the equipment shall be rectified or replaced by the vendor, at no extra cost to the purchaser.

**5.0** High, reliability of the pumps is an essential requirement. It is therefore essential that the bidder chooses a standard proven model from the range of pumps manufactured. A comprehensive list of similar installations shall be submitted along with the bid.



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## 6.0 OTHER REQUIREMENTS:

**6.1** The submersible Sump pumps shall meet the technical requirements of Section-I as well as Section-II.

**6.2** The Quality Plans enclosed in the specification are for bidder's guidance only. The bidder shall comply with these and other minimum requirements specified in the specification and shall furnish their own quality plan in the event of order based upon guidance given therein, for approval of BHEL/Customer as applicable to respective project.

## 7.0 Operational philosophy:

### 7.1 Controls for **TYPE A (Fixed Duty Submersible pumps)**:

Submersible Sump Pumps shall be controlled through a Wall mounted starter cum local control panel (in bidder's scope).

The local control panel shall be Relay based. The starter cum local control panel shall be suitable for outdoor duty and to be provided with protection.

The following controls/interlocks shall be provided in the local control panel.

- (a) Start/stop facility.
- (b) If any of the working sump pumps trips due to electric fault etc. the standby sump pump will come into operation automatically.
- (c) Selector switch for main/standby selection.
- (d) One number level switch (very high level) provided in the sump shall start second sump pump in the event of very high water level in the sump.
- (e) One number level switch (high level) provided in the sump shall start one number sump pump in the event of high water level in the sump.
- (f) One number level switch (low level) provided in the sump shall trip the running pumps in the event of low water level in the sump.
- (g) Sump pump status indication (ON/Off/Trip).
- (h) Indication for failure of any sump pump.
- (i) Indication for Low voltage, low level, high level, very high level and overload.
- (j) Ammeter shall be provided in LCP if motor rating is 30 KW or above.
- (k) Power and Control circuits shall be with MCCB.
- (l) Alarm shall be annunciated in the event of low water level in the sump.

**Note:** Level switches shall be top mounted displacer type.

### 7.2 Controls for **TYPE B (Portable Trolley mounted Horizontal Centrifugal Sump Pumps)**:

- Each Motor driven sump pump shall be provided with integral level switch mounted on pump frame for tripping the pump at low water level. The additional instruments/ interlocks



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required for pump - motor safety shall be also provided.

- Each motor driven Portable Type Sump pump shall be provided with starter panel as indicated above at S. No. 2.2.2 (b).
- The start/ stop P.B. for pumps shall be provided in the panel being supplied by the bidder. Power and Control circuits shall be with MCCB. Any additional feature Specified in Data Sheet-A shall be provided.

The following controls / interlocks shall be provided in the local control panel.

- a. Start / stop facility.
- b. One number level switch (very low level) provided along with the pump shall trip the pump in the event of very low water level in the sump
- c. Sump pump status indication (on / off / trip).
- d. Indication for failure sump pump.
- e. Indication for low voltage, low level and overload.

### **7.3 Controls for TYPE C (Portable Submersible pumps):**

Each submersible pump shall be provided with integral float type level switch mounted on pump frame for tripping the pump at low water level. The additional instruments/ interlocks required for pump - motor safety shall also be provided.

Each Portable type Sump pump shall be provided with starter cum local control panel as indicated above at S.No. 2.2.2 (c).

The start/ stop P.B. for pumps shall be provided in the panel being supplied by the bidder. Power and Control circuits shall be with MCCB. Any additional feature Specified in Data Sheet-A shall be provided.

The following controls / interlocks shall be provided in the local control panel.

- a. Start / stop facility.
- b. One number level switch (very low level) provided along with the pump shall trip the pump in the event of very low water level in the sump
- c. Sump pump status indication (on / off / trip).
- d. Indication for failure sump pump.
- e. Indication for low voltage, low level and overload.

**8.0** No external water supply shall be available for the cooling/sealing of sump pumps. The portable type sump pumps shall be oil filled type.

**9.0** The materials of construction for various components specified are the minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty.

**10.0** The makes of various Bought-Out-Items of bidder shall be subject to Purchaser's approval.

**11.0** It is mandatory for the bidder to submit along with the bid, the deviations if any whether major or minor in the schedule of deviations only. In the absence of deviations listed in the Schedule of Deviations, the offer shall be deemed to be in full conformity with the specification, notwithstanding anything else stated elsewhere in bidder's offer, data sheets etc. The bidder's deviations or implied/ indirect deviations in data sheets, etc.





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shall not be binding on the purchaser.

- 12.0** The bidder shall guarantee the performance of pump- motor units along with accessories for rated, performance duties, including the acoustical/ vibrational aspects for the stipulated limits specified elsewhere in the specification.

**NOTE:** The discharge rate of sump pump is very much uncontrolled. As such pump should be capable to operate even under a condition of as low as 25% of specified total head.

**13.0 DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE:**

- a. Delivery of Equipment shall be as per NIT.
- b. The drawings to be submitted by bidder in event of award of contract:
  - Technical Data Sheets of pump and motor
  - GA drawings of pumps,
  - Control philosophy & GA drawing of control panel.
  - Quality Plan.
  - O & M Manual.
- c. Drawings submission schedule after the award of contract shall be as below:

| PACKAGE                                      | BHEL DRG NO        | DRG TITLE                                                               |
|----------------------------------------------|--------------------|-------------------------------------------------------------------------|
| <b>Sump Pumps/<br/>Submersible<br/>pumps</b> | PE-V8-426-100-N001 | TDS AND PERFORMACE CURVES OF SUMP PUMPS                                 |
|                                              | PE-V8-426-100-N002 | GENERAL ARRANGEMENT AND CROSS SECTIONAL -SUMP PUMPS                     |
|                                              | PE-V8-426-100-N003 | TDS AND CURVES FOR MOTORS (IF APPLICABLE) OF SUMP PUMPS                 |
|                                              | PE-V8-426-100-N004 | C&I Doc. -WRITE UP, WIRING DIAGRAM & GA OF CONTROL PANEL FOR SUMP PUMPS |
|                                              | PE-V8-426-100-N005 | QP- SUMP PUMPS                                                          |
|                                              | PE-V8-426-100-N006 | O&M MANUAL-SUMP PUMPS                                                   |

- 14.0** Sub-Vendor List shall be furnished during detailed engineering. In case, Bidder offer makes other than the given list, the same shall be subject to approval of Customer/BHEL.



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**15.0** It is mandatory for the bidders to submit along with the bid the deviations if any whether major or minor in the schedule of deviations only. ***In the absence of deviations listed in the schedule of deviations the offer shall be deemed to be in full conformity with the specification "non-withstanding" anything else stated elsewhere in bidder's offer, data sheets etc. The implied/ indirect deviations in data sheets etc. Shall not be binding on the purchaser.***

**16.0** The following documents only shall be furnished by the bidder with his offer:

- a) Compliance certificate duly signed and stamped.
- b) GA drawings of pumps with motors (shall be only for reference purpose, same shall not be reviewed/commented by purchaser at this stage and shall be subject to approval only during contract).

**Apart from above no other drgs./docs./data sheets etc. are required to be submitted at bid stage and even if furnished shall not be taken cognizance of.**

**In case of any deviation from this technical specification, the same shall be indicated in the schedule of deviations as per Section-IIIC or NIT. In the absence of duly filled schedules it will be assumed that the bid strictly conforms to the specification.**

**17.0** Sump pumps/submersible pumps packing procedure before dispatch

The purpose of this procedure is to outline the requirements and procedures for protecting the equipment's during shipment and preserving during the storage.

**17.1 Preparation for Packing:**

- After testing, operation, all fluids e.g. water etc., shall be completely drained from all parts, and the equipment blown dry.
- All material shall be cleaned internally and externally to remove, scale, rust fillings and any other foreign material.
- The pumps shall be placed on a strong wooden base & bolted to the wooden base using the foundation holes for further transportation up to site.

**17.2 Protection of parts:**

- Pumps shall be packed in properly in high grade bubble plastic wrap for transportation, and long storage at site.
- Sump pumps items shall be packed in proper sizes of wooden cases. High grade woods like Rubber woods, jungle wood, hard wood, mango wood, pine wood, etc. is used for packing.
- Loose material, & Electrical & Electronics items shall be packed in corrugated box and plastic bags with proper tagging and marking of handle with care in proper sizes of wooden cases
- All finished (or) machined (External C.S. Surfaces shall be protected against corrosion with corrosion resisting coating, which is easily removable (Compound shall be such that it will remain on the surface at temperature normally encountered during shipping & storage).
- All machined surfaces shall be protected from mechanical damage. All external unfinished carbon steel surfaces shall be sand blasted & shall be coated with rust preventive primer.





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- Flanged opening if any shall be covered with blank flanges sealed with blank gasket of natural rubber or equivalent. Butt welded opening shall be closed with temporary closing covers. Internal threads shall be protected with metal plug sealed with Teflon tape (if applicable). External thread shall be protected with PVC sleeve.
- Wooden cases shall be covered with HDPE cloth from inside wooden box and the top. All the opening in sump pumps shall be closed properly by suitably covering to prevent foreign material entering in opened space.
- All the equipment shall be protected for entire period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage. All MS parts which are not painted shall be provided with coating of grease.
- Clay Desiccant or such other moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.

### **17.3 Preservation**

The equipment's shall be stored under closed/open space in packed condition until installation. The packages containing loose plates and gaskets are to be protected from extreme climatic conditions.

### **17.4 Additional Dispatch Requirements**

MDCC after final inspection shall be provided to vendor on the basis of following: -

- i) List of items packed in each box with description & quantity.
- ii) Photograph of each sump pump, control panel, hose pipe and each box in open & closed condition.
- iii) Bidder to include handling instructions in engineering drg/doc and packing to be done in such a way to avoid damage of items in transit and long storage at site and same shall be approved in contract stage by BHEL/Customer

iv)

### **18.0 BIDDER TO COMPLY FOLLOWING AFTER PLACEMENT OF PO:**

- i. Supplier to submit detailed ' Bill of Material ' (BOM) at the time of drawing /document submission after placement of PO. Each item of the BOM to be uniquely identified with item code no. or item serial no.
- ii. Supplier to ensure that all items which will find separate mention in the packing list are covered in this detailed BOM.
- iii. Supplier to also give the following undertaking in the BOM:

"The BOM provided herewith completes the scope (in content and intent) of material supply under PO No. ...., dated .....

Any additional material which may become necessary for the intended application of the supplied item(s)/package will be supplied free of cost in most reasonable time."

**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/contactors 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 runway 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.



TITLE:  
**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**  
**SPECIFIC TECHNICAL REQUIREMENTS**

SPEC. NO.: **PE-TS-426-100-N002**  
SECTION: **I**  
SUB-SECTION: **IB**  
REV. NO. **0** DATE **07.02.2020**  
SHEET **1** OF **1**

**SUB-SECTION – IB**  
**SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)**



**TITLE :**  
**ELECTRICAL EQUIPMENT SPECIFICATION**  
**FOR**  
**SUMP PUMPS**  
**1X660 MW UPRVUNL PANKI TPS**

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION :

REV NO. **00** : DATE : 01.02.2020

SHEET : 1 OF 3

**TECHNICAL SPECIFICATION**  
**FOR**  
**SUMP PUMPS**  
**(ELECTRICAL PORTION)**

|                                                                                  |                                                                                                                                     |                                       |
|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
|  | <b>TITLE :</b><br><b>ELECTRICAL EQUIPMENT SPECIFICATION</b><br><b>FOR</b><br><b>SUMP PUMPS</b><br><b>1X660 MW UPRVUNL PANKI TPS</b> | SPECIFICATION NO.                     |
|                                                                                  |                                                                                                                                     | VOLUME NO. : <b>II-B</b>              |
|                                                                                  |                                                                                                                                     | SECTION :                             |
|                                                                                  |                                                                                                                                     | REV NO. <b>00</b> : DATE : 01.02.2020 |
|                                                                                  |                                                                                                                                     | SHEET : 2 OF 3                        |

#### 1.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for **SUMP PUMPS**.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

#### 2.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:**

Refer “Electrical Scope between BHEL and Vendor”.

#### 3.0 **DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of



**TITLE :**  
**ELECTRICAL EQUIPMENT SPECIFICATION**  
**FOR**  
**SUMP PUMPS**  
**1X660 MW UPRVUNL PANKI TPS**

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compliance certificate/No deviation certificate.

- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

**4.0 List of enclosures :**

- a) Electrical scope between BHEL & vendor
- b) Quality plan for motors
- c) Datasheet A (Annexure- I)
- d) Customer (M/s DCPL) specification for Motors
- e) Datasheet-C
- f) Electrical Load data format (Annexure –II)
- g) BHEL cable listing format (Annexure –III)

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

PACKAGE: SUMP PUMP (Supply Package)

PROJECT: 1X660 MW UPRVUNL PANKI TPS

| <u>S.NO</u> | <u>DETAILS</u>                                                                                                                                                   | <u>SCOPE SUPPLY</u> | <u>SCOPE E&amp;C</u> | <u>REMARKS</u>                                                                                                                                                                                                                                                                |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1           | 415 V 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. |
| 2           | Local Push Button Station ( for motors)                                                                                                                          | BHEL                | BHEL                 | Located near the motors.                                                                                                                                                                                                                                                      |
| 3           | Power cables, control cables and screened control cables                                                                                                         | BHEL                | BHEL                 | Incoming cable from BHEL supplied MCC will be informed by BHEL. Screened control cable between DCS & field equipment will also be informed by BHEL. Vendor shall provide lugs & glands accordingly.                                                                           |
| 4           | Cable trays, accessories & cable trays supporting system                                                                                                         | BHEL                | BHEL                 |                                                                                                                                                                                                                                                                               |
| 5           | Cable glands and lugs for equipments supplied by Vendor                                                                                                          | Vendor              | BHEL                 | 1. Double compression Ni-Cr plated brass cable glands<br>2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.                                                                                                                             |
| 6           | Conduit and conduit accessories for cabling between equipments supplied by vendor                                                                                | BHEL                | BHEL                 |                                                                                                                                                                                                                                                                               |
| 7           | Equipment grounding & lightning protection                                                                                                                       | BHEL                | BHEL                 |                                                                                                                                                                                                                                                                               |
| 8           | Below grade grounding                                                                                                                                            | BHEL                | BHEL                 |                                                                                                                                                                                                                                                                               |
| 9           | LT Motors with base plate and foundation hardware                                                                                                                | Vendor              | BHEL                 | Makes shall be subject to BHEL approval at contract stage.                                                                                                                                                                                                                    |
| 10          | Mandatory spares                                                                                                                                                 | Vendor              | -                    | Vendor to quote as per specification.                                                                                                                                                                                                                                         |
| 11          | Recommended O & M spares                                                                                                                                         | Vendor              | -                    | As per specification                                                                                                                                                                                                                                                          |
| 12          | Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system). | Vendor              | BHEL                 |                                                                                                                                                                                                                                                                               |
| 13          | Electrical equipment GA drawing                                                                                                                                  | Vendor              | -                    | For necessary interface review.                                                                                                                                                                                                                                               |

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL after award of contract.

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

PACKAGE: SUMP PUMP (Supply Package)

2. All QPs shall be subject to approval of BHEL after award of contract without any commercial implication.

| DATA SHEET A |                                                            |                                                 |
|--------------|------------------------------------------------------------|-------------------------------------------------|
| SL NO.       | DESCRIPTION                                                |                                                 |
|              |                                                            | 1X660 MW UPRVUNL PANKI TPS EXT.                 |
| <b>A</b>     | <b>General</b>                                             |                                                 |
| 1            | Manufacturer & country of origin                           | DURING DETAILED ENGINEERING                     |
| 2            | Motor type                                                 | SQUIREL CAGE INDUCTION MOTOR                    |
| 3            | Efficiency class                                           | IE3                                             |
| 4            | Type of starting                                           | DOL                                             |
| 5            | Maximum acceptable kW rating of LV motor                   | 200                                             |
| 6            | Rating up to which Single phase motors permitted.          |                                                 |
| 7            | Installation (Indoors/ Outdoors)                           | indoor/outdoor                                  |
| 8            | Degree Of Protection                                       | IP55 WITH CANOPY FOR OUTDOOR<br>IP55 FOR INDOOR |
| 9            | Name of the equipment driven by motor & Quantity           | DURING DETAILED ENGINEERING                     |
| 10           | Maximum Power requirement of driven equipment              | DURING DETAILED ENGINEERING                     |
| 11           | Rated speed of Driven Equipment                            | As per system requirement                       |
| 12           | Design ambient temperature (Degree Celcius)                | 50 deg C                                        |
| <b>B</b>     | <b>Design and Performance Data</b>                         |                                                 |
| 1            | Frame size & type designation                              | DURING DETAILED ENGINEERING                     |
| 2            | Type of duty                                               | AS PER REQUIREMENT                              |
| 3            | Rated Voltage                                              | 240/415 V                                       |
| 4            | Rated Frequency                                            | 50 Hz                                           |
| 5            | System fault level at rated voltage                        | 50kA for 1 sec                                  |
| 6            | LV System grounding                                        | solidly grounded                                |
| 7            | Permissible variation for                                  |                                                 |
| a            | Voltage                                                    | +/-10%                                          |
| b            | Frequency                                                  | +/-5%                                           |
| c            | Combined voltage & frequency                               | 10%                                             |
| 8            | Rated output at design ambient temp (by resistance method) | as per requirement                              |
| 9            | Synchronous speed & Rated slip                             | as per requirement                              |



|    |                                                                    |                                                                                                                                                                                            |
|----|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10 | Minimum permissible starting voltage                               | 80% of rated voltage                                                                                                                                                                       |
| 11 | TYPE OF STARTER PROVIDED IN MCC                                    | As per system requirement                                                                                                                                                                  |
| 12 | Starting time in sec with mechanism coupled                        |                                                                                                                                                                                            |
| a  | At rated voltage                                                   | As per system requirement                                                                                                                                                                  |
| b  | At min starting voltage                                            |                                                                                                                                                                                            |
| 13 | Locked rotor current as percentage of FLC (including IS tolerance) | The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance)<br>(a) Below 110KW : 10.0<br>(b) From 110 KW & upto 200 KW : 9.0 |
| 14 | Torque                                                             |                                                                                                                                                                                            |
| a  | Starting                                                           | a) Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.                                                             |
| b  | Maximum                                                            | B) Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.                                                               |
| 15 | Permissible temp rise at rated output over ambient temp & method   | Thermal class 155 (F) insulation, temperature rise limited to class-B.                                                                                                                     |
| 16 | Noise level in (dB)                                                | 85 (dB) at 1 M                                                                                                                                                                             |
| 17 | Amplitude of vibration                                             | As per IS-12075/IEC-60034-14                                                                                                                                                               |
| 18 | Efficiency & P.F. at rated voltage & frequency                     |                                                                                                                                                                                            |
| a  | At 100% load                                                       | Efficiency as per IS 12615, IEC: 60034-30 (Latest                                                                                                                                          |

|          |                                                        |                                                                                                                              |
|----------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| b        | At 75% load                                            | revision), P.F. as per requirement.                                                                                          |
| c        | At starting                                            | Efficiency as per IS 12615, IEC: 60034-30 (Latest revision), P.F in line with starting requirement as per relevant standard. |
| <b>C</b> | <b>Constructional Features</b>                         |                                                                                                                              |
| 1        | Method of connection of motor driven equipment         | As per system requirement                                                                                                    |
| 2        | Applicable Standard                                    | as per relevant standard                                                                                                     |
| 3        | DOP of Enclosure                                       | IP55 WITH CANOPY FOR OUTDOOR<br>IP55 FOR INDOOR                                                                              |
| 4        | Method of cooling                                      | IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA).                                                                               |
| 5        | Class of insulation                                    | All motors shall have class F insulation but limited to class B temperature rise                                             |
| 6        | Main terminal box                                      |                                                                                                                              |
| a        | Type                                                   | Refer Specific technical requirement for motors                                                                              |
| b        | Power Cable details (Conductor, size, armour/unarmour) | 1.1 kV XLPE armour cable, size shall be provided during detailed engineering                                                 |
| c        | Cable Gland & lugs details (Size, type & material)     | Refer Specific technical requirement for motors                                                                              |
| d        | Permissible Fault level ( kArms & duration in sec)     |                                                                                                                              |
| e        | Degree of Protection                                   |                                                                                                                              |
| 7        | Earth Conductor Size & Material                        | Refer Specific technical requirement for motors                                                                              |
| 8        | Space heater details (30KW & ABOVE) (Voltage & watts)  | Refer Specific technical requirement for motors                                                                              |
| 9        | Flame proof motor details (if applicable)              | During detailed engineering                                                                                                  |
| a        | Enclosure                                              |                                                                                                                              |
| b        | suitability for hazardous area                         |                                                                                                                              |
| i        | Zone O / I / II                                        |                                                                                                                              |
| ii       | Group IIA / IIB / IIC                                  |                                                                                                                              |
| c        | Degree of Protection                                   |                                                                                                                              |
| 9        | No. of Stator winding                                  | As per system requirement                                                                                                    |
| 10       | Winding connection                                     | As per system requirement                                                                                                    |
| 11       | Kind of rotor winding                                  | As per system requirement                                                                                                    |
| 12       | Kind of bearings                                       | Refer Specific technical requirement for motors                                                                              |
| 13       | Direction of rotation when viewed from NDE             | Motor shall be bi-directional                                                                                                |

|          |                                                          |                                                                                                                    |
|----------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| 14       | Paint Shade & type                                       | Glossy light grey finish no 631 of IS 5, for details refer Specific technical requirement for motors               |
| 15       | Net weight of motor                                      | DURING DETAILED ENGINEERING                                                                                        |
| 16       | Outline mounting drawing No (To be enclosed as annexure) | DURING DETAILED ENGINEERING                                                                                        |
| <b>D</b> | <b>Characteristic curves/ drawings</b>                   |                                                                                                                    |
| 1        | (To be enclosed for motors of rating >55KW)              | DURING DETAILED ENGINEERING                                                                                        |
| 2        | Torque speed characteristic                              |                                                                                                                    |
| 3        | Thermal withstand characteristic                         |                                                                                                                    |
| 4        | Current vs time                                          |                                                                                                                    |
| 5        | Speed vs time                                            |                                                                                                                    |
| <b>E</b> | <b>Tests on motors</b>                                   | As applicable (As per QAP/For Project specific requirement if any refer Specific technical requirement for motors) |

**CHAPTER 17 : AC & DC MOTORS****1.00 MOTORS****1.1 SCOPE**

This specification is intended to cover design, manufacture, assembly and testing of AC Squirrel Cage Induction Motors for use in Thermal Power Plants and is supplement to the driven equipment specifications under which these motors are being procured for the project.

**SITE CONDITIONS**

Site conditions are covered in 'Project Data', contained in specification of the driven equipment.

**1.2 Gases, Fumes & Dust Particles**

1.2.01 General - Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical, conducive to fungus growth.

**1.2.02 Dust Particles**

1 Outdoor locations - Heavily dusty with abrasive dust and coal particles of size five (5) to hundred (100) microns present in atmosphere in large quantity.

2 Indoor Locations.

2.1 Coal conveyors - As for outdoor as per clause 1.02.02.1 above.

2.2 Other locations - Lightly dusty with abrasive dust and coal particles of size five (5) to twenty (20) microns present in atmosphere.

**1.2.03 Special Fumes**

1 Water treatment plant and acid cleaning room - Acid and alkali fumes present.

2 Fuel oil pumping areas & Hydrogen generation plant - Explosive fumes (flameproof motors required).

1.2.04 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

**1.3 LOCATION OF MOTOR - As required**

1.4 **SPECIFICATIONS & STANDARDS**.....Motors shall comply with the latest revisions of all relevant standards of BIS (IS-325, IS-900, IS-996, IS-1231, IS-1885, IS-2148, IS-2223, IS-2253, IS-2254, IS-2848, IS-3202, IS-4029, IS-4691, IS-4722, IS-4728, IS-4889, IS-6362, IS-7816, IS-8223, IS-8789, IS: 12615, IS:3177 and IEC : 60034 3Φ Induction motor) except as modified herein or in driven equipment specification.

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



- 1.24.1 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 conforming 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**



1 x 660 MW – Panki Thermal Power Station

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



**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, 3 $\Phi$ , 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, 3 $\Phi$ , 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, 3 $\Phi$ , 3W, 50 Hz effectively earthed      | Motors below and including 200kW                           |
|                                                                                                                                                                                                                                            | Fault level                                         | 50kA for 1 second                                          |
|                                                                                                                                                                                                                                            | 110V, 1 $\Phi$ , 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. |                                                     |                                                            |



TITLE:  
**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**

**SPECIFIC TECHNICAL REQUIREMENTS**

SPEC. NO.: **PE-TS-426-100-N002**

SECTION: **I**

SUB-SECTION: **IC**

REV. NO. **0** DATE **07.02.2020**

SHEET **1** OF **1**

**SUB-SECTION – IC**

**SPECIFIC TECHNICAL REQUIREMENTS (C &I)**



Technical specification  
for  
**1X660 MW TPS PANKI EXTN.**

REV. NO. 00 DATE

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- 1.1 Specific Technical Requirement

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- 1.3 Instrument stub details
- 1.4 Instrument installation diagram
- 1.5 LCP Specification & Quality Plan
- 1.6 Applicable Cable Types
- 1.7 Drive Control Philosophy
- 1.8 Process connection & piping





Technical specification  
for  
**1X660 MW TPS PANKI EXTN.**

REV. NO.

00

DATE : 20.07.2019

**SECTION -C**

**SPECIFIC TECHNICAL REQUIREMENT**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                 |  |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>SUMP PUMPS</b> |  |
| <p><b>Specific Technical Requirements (C&amp;I):</b></p> <p>Sump Pumps shall be controlled through Relay based control system <b>(Bidder's scope of supply).</b><br/>Relay based panel along with control desk shall be provided with colored Mimic, H.W. Annunciator, Push Buttons., Indicators, indication Lamps and Ammeters.</p> <p>1.0 The Bidder shall provide complete Instrumentation for control, monitoring and operation. 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 Contractor's C&amp;I representative shall be present at BHEL-PEM for 3 man-days, for preparation of Control scheme. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.</p> <p>6.0 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</p> |                                                                 |  |

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|      | <b>1 X 660MW PANKI TPS EXTN.</b>                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|      | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>SUMP PUMPS</b>                                                                                                                                                                                                                                                                                                                                                                          |  |
|      | <p>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>                                                                                       |  |
| 7.0  | For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.                                                                                                                                                                                                                                                                                                                                   |  |
| 8.0  | Bidder shall provide Cable Schedule in BHEL excel format which shall be provided during detailed engineering. Also, Cable engineering i.e. Cable schedule, Cable Interconnections for Complete System shall be in Bidders' scope.                                                                                                                                                                                                        |  |
| 9.0  | 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.                                                                                                                                                                         |  |
| 10.0 | MOVs (Motorized Valves) shall be integral type, if applicable.                                                                                                                                                                                                                                                                                                                                                                           |  |
| 11.0 | Bidder to furnish electrical load/UPS load data during detailed engineering.                                                                                                                                                                                                                                                                                                                                                             |  |
| 12.0 | 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. |  |
| 13.0 | Power supply derived for Transmitters, contact interrogation, interposing relay and solenoid shall generally be ungrounded 24V D.C only.                                                                                                                                                                                                                                                                                                 |  |
| 14.0 | The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Solenoid Valve shall be rated for 24V DC only.                                                                                                                                                                                                                                                                                              |  |
| 15.0 | Bidder to supply all the instruments (PT, PG, LS, 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.                                                                                                                                                |  |

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|      | <b>1 X 660MW PANKI TPS EXTN.</b>                                                                                                                                                                                                                                                             |  |
|      | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>SUMP PUMPS</b>                                                                                                                                                                                                                              |  |
|      | <p>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>.</p>                                                                                                                              |  |
| 16.0 | 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.                                    |  |
| 17.0 | Use of process actuated switches shall be avoided unless Unavoidable.                                                                                                                                                                                                                        |  |
| 18.0 | 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.                         |  |
| 19.0 | Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However, any instrument/ analyser installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.  |  |
| 20.0 | DP instruments with minimum Capillary length of 15m is to be supplied.                                                                                                                                                                                                                       |  |
| 21.0 | All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications i.e Temperature transmitter (TT) shall be of dual input type. Head mounted Temperature transmitter is NOT acceptable. All TT shall be field mounted. |  |
| 22.0 | Instruments shall be provided along with Chemical seal/ diaphragm seal.                                                                                                                                                                                                                      |  |
| 23.0 | All field instruments enclosure shall be IP65 local panel/cabinet enclosure shall be IP 65.                                                                                                                                                                                                  |  |
| 24.0 | 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.                                                                            |  |
| 25.0 | The junction boxes/LIEs for termination of instruments are in bidder's scope.                                                                                                                                                                                                                |  |

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|      | <b>1 X 660MW PANKI TPS EXTN.</b>                                                                                                                                                                                                                                                                                                                       |  |
|      | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>SUMP PUMPS</b>                                                                                                                                                                                                                                                                                        |  |
| 26.0 | 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.  |  |
| 27.0 | The make of all the items shall be from approved sub-vendor list.                                                                                                                                                                                                                                                                                      |  |
| 28.0 | Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.                                                                                                                                                                                                                                      |  |
| 29.0 | All Instruments must have separate tapping lines. Sharing of the same tapping pipe for redundant instruments or various different instruments is not acceptable.                                                                                                                                                                                       |  |
| 30.0 | 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.                                                                                                                     |  |
| 31.0 | 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.                                                                                                                                            |  |
| 32.0 | 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.                                                                                                                 |  |
| 33.0 | 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 bidder's scope of supply. |  |
| 34.0 | Bidder to provide erection hardware including canopies, structural steel as required.                                                                                                                                                                                                                                                                  |  |
| 35.0 | Bidder to perform tests of C&I items/instruments/systems as per quality plans/type test attached in the specification.                                                                                                                                                                                                                                 |  |
| 36.0 | Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of                                                                                                                                                                                                                   |  |

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|      | <b>1 X 660MW PANKI TPS EXTN.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
|      | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>SUMP PUMPS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
|      | <p>suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.</p>                                                                                                                                                                                                                                                                                                                                                                            |  |
| 37.0 | 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.                                                                                                                                                                                                                                                                                                                    |  |
| 38.0 | 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.                                                                                                                                                                                      |  |
| 39.0 | The specifications for instruments mentioned in the specification are minimum requirements. Datasheets of instrument shall be subject to customer/owner approval.                                                                                                                                                                                                                                                                                                                                                           |  |
| 40.0 | All approval/Inspection are to be carried out by Owner or owner appointed agency only.                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| 41.0 | Drawings/Documents and data to be furnished after award of the contract shall be in line with MDL furnished elsewhere in the specification.                                                                                                                                                                                                                                                                                                                                                                                 |  |
| 42.0 | Mandatory spare list as per 'List of mandatory spares' attached elsewhere in the specification is in bidder's scope.                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| 43.0 | Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract:                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
| 44.0 | <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>                                                                                                                                                                                                                                                                                                       |  |
|      | <p><b>Note: -</b></p> <p>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.</p> <p>2. The above given scope is indicative &amp; minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be</p> |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                 |  |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I)<br/>SUMP PUMPS</b> |  |
| <p>supplied by bidder without any technical, commercial and delivery implication to BHEL.</p> <p>3. Documents of C&amp;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.</p> <p>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.</p> <p>5. In case of any discrepancy in Section-C and Section-D of the specification, Section-C shall prevail.</p> |                                                                 |  |

**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.





Technical specification  
for  
**1X660 MW TPS PANKI EXTN.**

REV. NO.

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DATE : 20.07.2019

# **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.



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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.                                                                                                                                                       |

|           |                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |                                                                                                              | +/- 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

**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                                                              |

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



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### 2.13.00 PROCESS ACTUATED SWITCHES

| Sr No.   | Features        | Essential/Minimum Requirements                                                |                                                                                             |                                                                                                           |
|----------|-----------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
|          |                 | Pressure/Draft Switches/DP Switches                                           | Temperature switches                                                                        | Level switches                                                                                            |
| <b>1</b> | Sensing Element | Piston actuated for high pressure and diaphragm or bellows for low pr./vacuum | Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (10 m minimum) | Capacitance types for oil and dirty medium, water, condensate application. Float type for applications as |

|           |                                         |                                                                                                                                                          |                                               |                                                                                                                                                                                                                            |
|-----------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |                                         |                                                                                                                                                          |                                               | decided by owner during detailed engineering. Capacitance/Conductivity/Ultrasonic type for acid and alkali application. RF/ Ultrasonic type for ash hopper, ash slurry application. Detailed spec are also included below. |
| <b>2</b>  | Material of sensing element & movement. | 316 SS                                                                                                                                                   | Bulb 316 SS/<br>capillary 304 SS              | 316 SS                                                                                                                                                                                                                     |
| <b>3</b>  | End connection                          | ½ inch NPT (F)                                                                                                                                           | ½ inch NPT (F)                                | Manufacturer standard                                                                                                                                                                                                      |
| <b>4</b>  | Over range proof pressure               | 150% of max. design pr                                                                                                                                   | -                                             | 150% of max. design pressure                                                                                                                                                                                               |
| <b>5</b>  | Repeatability                           | ± 0.5% of full range                                                                                                                                     |                                               |                                                                                                                                                                                                                            |
| <b>6</b>  | No. of contacts                         | 2 Nos. +2NC. SPDT snap action dry contact. Auto reset with internal Adjustable snap action micro switch.                                                 |                                               |                                                                                                                                                                                                                            |
| <b>7</b>  | Rating of contacts                      | 60 V DC, 6 VA (or more if required by DDCMIS/PLC)                                                                                                        |                                               |                                                                                                                                                                                                                            |
| <b>8</b>  | Elect. Connection                       | Plug in socket                                                                                                                                           |                                               |                                                                                                                                                                                                                            |
| <b>9</b>  | Set point                               | Provided over full range. Differential shall be adjustable.                                                                                              |                                               |                                                                                                                                                                                                                            |
| <b>10</b> | Dead band adjustment                    | Adjustment upto 10% at set points.                                                                                                                       |                                               |                                                                                                                                                                                                                            |
| <b>11</b> | Enclosure                               | Die cast Aluminum with stoved enamel black finish/SS316, Weather and dust proof as per IP-65. Epoxy painting shall be provided for corrosive atmosphere. |                                               |                                                                                                                                                                                                                            |
| <b>12</b> | Accessories                             | Siphon, snubber, chemical, pulsation dampers as required by process.                                                                                     | Thermo well of 316 SS and packing glands      | All mounting accessories                                                                                                                                                                                                   |
| <b>13</b> | Mounting                                | Suitable for enclosure/rack mounting or direct mounting                                                                                                  | Suitable for rack mounting or direct mounting | -                                                                                                                                                                                                                          |
| <b>14</b> | Power Supply ( wherever                 | 24 V DC, to be arranged by Bidder except for Ash Level Switches, where the same shall be as per Bidder's Standard practice.                              |                                               |                                                                                                                                                                                                                            |



|  |           |  |
|--|-----------|--|
|  | Required) |  |
|--|-----------|--|

**Notes:-**

- 1) 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) Pressure / Diff Pressure switches for very low pressure / DP measurements can have sensor material other than SS316 e.g. silicon etc., if the offered material is suitable for that application and the offered product is standard product of the manufacturer for very low pressure applications.
- 3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

**2.13.01 Conductivity Type Level Switch**

|                       |   |                                                                                                                          |
|-----------------------|---|--------------------------------------------------------------------------------------------------------------------------|
| Type                  | : | Conductivity discrimination.                                                                                             |
| Mounting              | : | Flanged – on standpipe.                                                                                                  |
| Probe MOC             | : | Stainless steel with high purity ceramic.                                                                                |
| Probe rating          | : | > Maximum design pressure of vessel.                                                                                     |
| Input                 | : | Four independent channel with selectable switching threshold for water conductivity.                                     |
| Relay Output          | : | Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.                                                                    |
| Contact type & rating | : | 2SPDT or 1 DPDT @ 5A 30V DC.                                                                                             |
| Faults Detection      | : | Power Fail/Electrode Connection<br>Open circuit/short circuit to ground,<br>Ground failure.<br>In built Fail Safe Logic. |
| Indicator             | : | One Red LED for steam/ one Green LED for water/ Two no. LED one each for Process & system fault.                         |
| Power supply          | : | Dual 230V AC, 50 Hz, 1Ph from UPS.                                                                                       |



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|               |   |                                                                                                                                                                                                      |
|---------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enclosure     | : | Corrosion resistant & wall mounting type. IP-65 or better (Explosion proof For NEC Class-1/2, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).                                      |
| Accessories   | : | i. PTFE cable from probe to electronics unit. Electronic unit shall be separate. Head mounted electronic unit is not preferred.<br>ii. Mounting accessories<br>iii. standpipe<br>iv. Washer & gasket |
| Test pressure | : | Two times rated pressure                                                                                                                                                                             |

### 2.13.02 Capacitance Type Level Switch

|                          |   |                                                                                                                                                                                        |
|--------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type                     | : | Capacitance type                                                                                                                                                                       |
| Probe                    | : | a) Rod or suspended electrode<br>b) Rope type probes may be used only where required probe length is greater than 3 meters.                                                            |
| Probe Mounting           | : | Stainless steel 1-1/2 ANSI RF Flange / 3/4"                                                                                                                                            |
| Material of construction | : | NPT (M)<br>316 SS                                                                                                                                                                      |
| Insulation               | : | PTFE Part/Full as per service.                                                                                                                                                         |
| Enclosure                | : | Powder/Epoxy coated Die cast Aluminum. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1/2, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable). |
| Ambient temperature      | : | 0-60 °C.                                                                                                                                                                               |
| Mounting                 | : | On Top                                                                                                                                                                                 |
| Supply voltage           | : | 230V AC, 50Hz from UPS / 24V DC                                                                                                                                                        |
| Relay output             | : | 2SPDT                                                                                                                                                                                  |
| Contact rating           | : | 5A min. at 240V AC on resistive load                                                                                                                                                   |
| Response time            | : | 100 m sec or better                                                                                                                                                                    |
| Cable connection         | : | Plug in type                                                                                                                                                                           |

Accessories : Counter flange, Cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.

### 2.13.03 RF TYPE LEVEL SWITCH

#### A. Electronic Controller

- |    |                      |   |                                                                                |
|----|----------------------|---|--------------------------------------------------------------------------------|
| 1. | Input Supply         | : | 230 V AC from UPS                                                              |
| 2. | Construction         | : | Cast Aluminum Housing                                                          |
| 3. | Relay Output         | : | 2 Nos. Relay Changeover Potential Free Contacts ( 2 SPDT)                      |
| 4. | Contact Rating       | : | 5A at 240 V AC & 0.25 at 220 V DC                                              |
| 5. | Class of Protection  | : | IP-66                                                                          |
| 6. | Ambient Temperature: | : | 55 Deg. C (Max)                                                                |
| 7. | Local Indication     | : | Local LED Indications                                                          |
|    | Green                | : | Normal Level                                                                   |
|    | Red                  | : | Alarm Level                                                                    |
|    | Yellow               | : | Probe Healthy                                                                  |
| 8. | Cable Connection     | : | 3/4" ET (2 Nos.) for Supply and Output<br>5/8" ET (1 No.) for Probe Connection |
| 9. | Repeatability        | : | 100%                                                                           |

#### B. Sensing Probe

- |    |                                                      |   |                                                                                                           |
|----|------------------------------------------------------|---|-----------------------------------------------------------------------------------------------------------|
| 1. | Type of Probe                                        | : | Rigid                                                                                                     |
| 2. | Material                                             | : | Stainless steel SS 316                                                                                    |
| 3. | Probe Head Housing                                   | : | Cast Aluminum                                                                                             |
| 4. | Insulation (B/W Active & Shield And Shield & Ground) | : | PTFE                                                                                                      |
| 5. | Probe Head Protection                                | : | IP-66                                                                                                     |
| 6. | Mounting                                             | : | Side Mounted                                                                                              |
| 7. | Cable Connection                                     | : | 5/8" ET (1No.)                                                                                            |
| 8. | Process Connection                                   | : | 40 NB BSP THREADED                                                                                        |
| C. | Signal Cable                                         | : | Coaxial cable for Connection Between Sensing probe and electronic Controller (@ 10 Mtrs. Per Level Probe) |

D. Application : Silos

### 2.14.00 SOLENOID VALVES

Solenoid valves shall fulfill the following requirements:



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- a. Type 2/3/4 way with body material of SS 316/Forged Brass and epoxy painting (depending on the application subject to Owner's approval during detailed Engg.). Material of Wetted parts shall be SS316.
- b. Power supply 24 V DC + 10%.
- c. Plug and socket electrical connection.
- d. Insulation: Class 'H'.
- e. All solenoid shall be with, LED indication, surge suppression diode circuits.

### 2.15.00 Power Cylinders (Pneumatic)

|                           |   |                                                                                                                                                                                                                                                                                                                       |
|---------------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mounting Type             | : | a) Fixed position mounting (End mounting).<br>b) Trunnion mounting                                                                                                                                                                                                                                                    |
| Control Signal            | : | 0.2 to 1 Kg/Sq. cm. from I/P converter for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line. The Pilot solenoid will have separate coils for open closing purpose.                                                                                                                  |
| Supply Air                | : | 0-7 Kg / Cm <sup>2</sup> .                                                                                                                                                                                                                                                                                            |
| Selection                 | : | Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.                                                                                                                                           |
| Casing                    | : | IP-65.                                                                                                                                                                                                                                                                                                                |
| Accessories (as required) | : | a) Air lock relay<br>b) Hand wheel.<br>c) Air filter regulator with gauge.<br>d) Volume Booster.<br>e) Limit Switches.<br>f) Positioner with Input, Output and supply pressure gauges.<br>g) Pilot Solenoid Valve (Double Coil type)<br>h) Position Transmitter (4-20 mA DC linear output, LVDT or non contact type). |
| Fail-safe operation       | : | Stay put, open or close position on pneumatic / electrical power supply failure as per process safety criteria.                                                                                                                                                                                                       |
| Repeatability             | : | Better than 0.5% of full travel.                                                                                                                                                                                                                                                                                      |



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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



**2.18.00 Limit switches**

For offsite plant application Limit switches shall be gold plated with high conductivity and non corrosive type. Contact rating shall be sufficient to meet the requirement of DDCMIS subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 65. Contact shall be either 1 no, DPDT or 2 nos. SPDT minimum.

For main plant application, limit switches are to be provided as per bidder standard and proven practice.

All limit switch shall be conform to IEC-60947-5-1.



1 x 660 MW - Panki Thermal Power Station

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



**2.23.21 POWER FACTOR METER (DIGITAL)**

|                  |   |                                                           |
|------------------|---|-----------------------------------------------------------|
| Type             | : | Electronic digital 7- segment with fluorescent display    |
| Input            | : | 4 - 20 mA DC                                              |
| Mounting         | : | Flush Panel, compatible for mounting on mosaic grid panel |
| Number of digits | : | 4 1/2 digit                                               |
| Face Dimension   | : | 192X192 mm                                                |
| Digit size       | : | Approximately 40 mm                                       |
| Range            | : | - 1 - 0 - + 1                                             |
| Accuracy         | : | $\pm 0.25$ %                                              |
| Display          | : | Red LED display                                           |
| Connection       | : | Plug in type                                              |
| Magnetic Shield  | : | Shielded Case                                             |

**2.23.22 SYNCHROSCOPE**

Synchroscope shall be designed to provide an illuminate and indication of phase and frequency difference between bus voltages and generator voltage. It shall denote the actual frequency difference corresponding to the inverse of time taken for one rotation of the illuminated vector spot. Synchroscope shall be designed as per IEC/DIN/BS standard.

|                 |   |                                                           |
|-----------------|---|-----------------------------------------------------------|
| Input           | : | Differential frequency & Differential Voltage             |
| Mounting        | : | Flush Panel, compatible for mounting on mosaic grid panel |
| Face Dimension  | : | 96 x 96 mm                                                |
| Accuracy        | : | $\pm 0.5$ %                                               |
| Magnetic Shield | : | Shielded Case                                             |

**2.24.00 CONTROL DESK / PANEL PUSH BUTTONS****2.24.01 PB/ ILPBs FOR ON/OFF, OPEN /CLOSE**

|                       |   |                                                                                           |
|-----------------------|---|-------------------------------------------------------------------------------------------|
| Type                  | : | Momentary/Miniaturized<br>Suitable for mosaic grid 24x48 Mm with 2 PB and 3 coloured LED. |
| Contact Configuration | : | 2 NO + 2 NC                                                                               |
| Contact Material      | : | Hard Silver Alloy                                                                         |
| Contact Rating        | : | 500V / 10 A                                                                               |
| Insulation Voltage    | : | 2 KV for 1 minute between terminals and earth                                             |
| Lamp Rating :-        |   |                                                                                           |
| a) Voltage            | : | 240 V AC                                                                                  |

|              |      |   |                                                                               |
|--------------|------|---|-------------------------------------------------------------------------------|
| b)           | Watt | : | 2 Watt (approx.)                                                              |
| Colour       |      |   |                                                                               |
| Red          | :    |   | ON/Start/Open ILPB                                                            |
| Green        | :    |   | OFF/Stop/Close ILPB                                                           |
| Red          | :    |   | energized, running, Start, valve open LED/Lamp                                |
| Green        | :    |   | de-energized, stopped, valve closed LED/Lamp                                  |
| Light yellow | :    |   | abnormal, discrepancy LED/Lamp                                                |
| Red          | :    |   | OFF/Stop/Close PB                                                             |
| Green        | :    |   | ON/Start/Open PB                                                              |
| Red          | :    |   | Emergency trip push buttons with red flap / Hinged Transparent acrylic cover. |

#### 2.24.02 PUSH BUTTON FOR Control DESK

|                     |   |                                                                    |
|---------------------|---|--------------------------------------------------------------------|
| Type                | : | Momentary mosaic grid mounted<br>24x48 mm size, single PB 18x40 mm |
| Colours             |   |                                                                    |
| DESK RELEASE PB     |   | - Yellow                                                           |
| Desk Lamp test PB   |   | - Blue                                                             |
| Desk Acknowledge PB |   | - Green                                                            |

#### 2.24.03 PUSH BUTTON FOR SEQUENCE START /RELEASE

Momentary (Miniaturised) suitable for mosaic grid 24x48 mm, 3 PB + 5 LED.

#### 2.24.04 PUSH BUTTON FOR ANNUNCIATION

|                     |   |                                                                                                                |
|---------------------|---|----------------------------------------------------------------------------------------------------------------|
| Contacts            |   |                                                                                                                |
| - Number & Type     | : | As per requirement                                                                                             |
| - Breaking capacity | : | 1 Amp, 220V DC<br>10 Amp, 600V AC                                                                              |
|                     |   | Different colours for Accept/Acknowledge -<br>Green, reset Grey, test - Yellow & Audio<br>Acknowledge - Black. |

#### 2.25.00 Digital Indicators for Control Desk Draw out section.

|                   |   |                                                        |
|-------------------|---|--------------------------------------------------------|
| Type              | : | Electronic digital 7- segment with fluorescent display |
| Input             | : | 4 - 20 mA DC                                           |
| Mounting          | : | Flush Panel                                            |
| Number of digits  | : | 3 1/2 digit, Float decimal.                            |
| Size              | : | 48 mm (W) x 24 mm (h)/50 mm x 25 mm                    |
| Accuracy          | : | 2.5% of final value                                    |
| Display           | : | Red LED display                                        |
| Temp. coefficient | : | 0.15%/deg C of measured value                          |



- ~~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 or 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                                                                                                                   |
|                   |   | 3 mm min. thickness Die cast aluminum for Flame proof/Explosion proof area.                                                                                                                     |
| Cable entry       | : | Bottom or Side                                                                                                                                                                                  |
| Cable glands      | : | Double compression type – Nickel plated Brass/SS316 with PVC hoods.                                                                                                                             |
| Mounting          | : | Indoor/Outdoor                                                                                                                                                                                  |
| No. of terminals  | : | As required with standardization with 20% spare of each size & type.                                                                                                                            |
| Terminals         | : | Phoenix/Wago (screw less rail mounted cage clamp type spring loaded suitable for conductor size up to 2.5 sq. mm)                                                                               |
| Grounding         | : | Two terminals for body and shield ground                                                                                                                                                        |
| Door              | : | Hinged, lockable type.                                                                                                                                                                          |
| Accessories       | : | 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. |

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.

|                                                                                   |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |                |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|----------------|
|  | <b>SPECIFICATION<br/>FOR<br/>MOTORISED VALVE ACTUATOR</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                      | SPECIFICATION NO.:                          |                |
|                                                                                   |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                      | VOLUME II B                                 |                |
|                                                                                   |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                      | SECTION D                                   |                |
|                                                                                   |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                      | REV. NO. 00                                 | DATE: 26.02.18 |
|                                                                                   |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                      | SHEET 1                                     | OF 4           |
| <b>Data Sheet A &amp; B</b>                                                       |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |                |
| DATA SHEET-A<br>(TO BE FILLED BY PURCHASER)                                       |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                      | DATA SHEET-B<br>(TO BE FILLED-UP BY BIDDER) |                |
| <b>GENERAL*</b>                                                                   | * PROJECT                                                 | 1 x 6600 MW PANKI Thermal Power Project                                                                                                                                                                                                                                                                                                                                                                                              |                                             |                |
|                                                                                   | OFFER REFERENCE                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |                |
|                                                                                   | * TAG NO. SERVICE                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |                |
|                                                                                   | * DUTY                                                    | <input type="checkbox"/> ON / OFF <input type="checkbox"/> INCHING                                                                                                                                                                                                                                                                                                                                                                   |                                             |                |
|                                                                                   | * LINE SIZE (inlet/outlet): MATERIAL                      |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |                |
|                                                                                   | * VALVE TYPE                                              | <input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE<br><input type="checkbox"/> BUTTERFLY                                                                                                                                                                                                                                                                                               |                                             |                |
|                                                                                   | * OPENING / CLOSING TIME                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |                |
|                                                                                   | * WORKING PRESSURE                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |                |
|                                                                                   | AMBIENT CONDITION                                         | SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF -20 to 70 DEG C AND RELATIVE HUMIDITY OF 0-95%                                                                                                                                                                                                                                                                                                                  |                                             |                |
|                                                                                   | VALVE SEAT TEST PRESS                                     | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                |
|                                                                                   | REQUIRED VALVE TORQUE                                     | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                |
|                                                                                   | ACTUATOR RATED TORQUE                                     | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                |
| <b>CONSTRUCTION AND SIZING</b>                                                    | CONSTRUCTION                                              | TOTALLY ENCLOSED, WEATHER PROOF, DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, NEMA6/IP:68                                                                                                                                                                                                                                                                                                                                     |                                             |                |
|                                                                                   | MECHANICAL POSITION INDICATOR                             | TO BE PROVIDED FOR 0-100% TRAVEL                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |                |
|                                                                                   | BEARINGS                                                  | DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                |
|                                                                                   | GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION       | METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.                                                                                                                                                                                                                                                                                                               |                                             |                |
|                                                                                   | SIZING                                                    | OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 90% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. <b>FOR REGULATING SERVICE - 150 STARTS/HR MINIMUM OR REQUIRED CYCLES WHICHEVER IS HIGHER..</b>                                                                                                                                               |                                             |                |
| <b>HANDWHEEL</b>                                                                  | * REQUIRED                                                | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO                                                                                                                                                                                                                                                                                                                                                                  |                                             |                |
|                                                                                   | * ORIENTATION                                             | <input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED                                                                                                                                                                                                                                                                                                                                                           |                                             |                |
|                                                                                   | *TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.       |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |                |
| <b>ELECTRIC ACTUATOR</b>                                                          | ACTUATOR MAKE/MODEL                                       | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                |
|                                                                                   | MOTOR MAKE / MODEL / TYPE / RATING (KW)                   | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                |
|                                                                                   | @ MOTOR TYPE                                              | SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF I.S. TOLERANCE                                                                                                                                                                                                                                                                                                                   |                                             |                |
|                                                                                   | ACTUATOR APPLICABLE WIRING DIAGRAM                        | <input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM)<br>A: <input type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00<br>B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00<br>C: <input checked="" type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00<br>D: <input type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11<br>E: <input type="checkbox"/> For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram |                                             |                |
|                                                                                   | COLOUR SHADE                                              | <input checked="" type="checkbox"/> RAL 7032                                                                                                                                                                                                                                                                                                                                                                                         |                                             |                |
|                                                                                   | PAINT TYPE (## Refer Notes)                               | <input type="checkbox"/> ENAMEL <input checked="" type="checkbox"/> EPOXY <input type="checkbox"/> .....                                                                                                                                                                                                                                                                                                                             |                                             |                |
|                                                                                   | SHAFT RPM                                                 | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                |
|                                                                                   | OLR SET VALUE                                             | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                |
|                                                                                   | @ STARTING / FULL LOAD CURRENT                            | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                |
|                                                                                   | NO. OF REV FOR FULL TRAVEL                                | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                |
|                                                                                   | @ PWR SUPP TO MTR / STARTER                               | 415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%                                                                                                                                                                                                                                                                                                                                                                                             |                                             |                |
|                                                                                   | @ CONTROL VOLTAGE REQUIREMENT                             | TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER<br><input type="checkbox"/> 230 V <input checked="" type="checkbox"/> 110 V                                                                                                                                                                                                                                                                                                       |                                             |                |



# SPECIFICATION FOR MOTORISED VALVE ACTUATOR

SPECIFICATION NO.:

VOLUME II B

SECTION D

REV. NO. 00

DATE: 26.02.18

SHEET 2

OF 4

## Data Sheet A & B

DATA SHEET-A  
(TO BE FILLED BY PURCHASER)

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

|                                                                                   |                                                                           |                                                                                                                                                        |  |  |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
|                                                                                   | @ ENCLOSURE CLASS OF MOTOR                                                | <input type="checkbox"/> IP 67 <input type="checkbox"/> FLAME PROOF                                                                                    |  |  |
|                                                                                   | @ INSULATION CLASS                                                        | CLASS-F TEMP. RISE LIMITED TO CLASS-B                                                                                                                  |  |  |
|                                                                                   | @ WINDING TEMP PROTECTION                                                 | <input checked="" type="checkbox"/> THERMOSTAT (3 Nos.,1 IN EACH PHASE)<br><input type="checkbox"/> -----                                              |  |  |
|                                                                                   | SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION                            | REQUIRED                                                                                                                                               |  |  |
| <b>INTEGRAL STARTER</b>                                                           | INTEGRAL STARTER                                                          | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                     |  |  |
|                                                                                   | TYPE OF SWITCHING DEVICE                                                  | <input checked="" type="checkbox"/> CONTACTORS(Reversing type) <input type="checkbox"/> THYRISTORS                                                     |  |  |
|                                                                                   | TYPE                                                                      | <input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)                                                        |  |  |
|                                                                                   | IF SMART                                                                  |                                                                                                                                                        |  |  |
|                                                                                   | a) SERIAL LINK INTERFACE                                                  | <input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED                                                                               |  |  |
|                                                                                   | b) SERIAL LINK PROTOCOL                                                   | <input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS<br><input type="checkbox"/> DEVICE NET <input type="checkbox"/> ..... |  |  |
|                                                                                   | c) SERIAL LINK MEDIA                                                      | <input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL<br><input type="checkbox"/> OFC                                  |  |  |
|                                                                                   | d) HAND HELD PROGRAMMER                                                   | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                |  |  |
|                                                                                   | e) TYPE OF HAND HELD PROGRAMMER                                           | <input type="checkbox"/> BLUETOOTH <input type="checkbox"/> INFRARED <input type="checkbox"/> .....                                                    |  |  |
|                                                                                   | f) MASTER STATION                                                         | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                |  |  |
|                                                                                   | g) MASTER STN INTRFACE WITH DCS                                           | <input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP                                                                                        |  |  |
|                                                                                   | h) DETAILS OF SPECIAL CABLE                                               | <input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED                                                                                |  |  |
|                                                                                   | STEP DOWN CONT. TRANSFORMER                                               | <input checked="" type="checkbox"/> REQUIRED                                                                                                           |  |  |
|                                                                                   | OPEN-STOP-CLOSE PB(running open/close LED) THREE POSITION SELECTOR SWITCH | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                     |  |  |
|                                                                                   | INDICATING LAMPS                                                          | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                     |  |  |
|                                                                                   | LOCAL-OFF- REMOTE S/S(THREE POSITION SELECTOR SWITCH)                     | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                     |  |  |
|                                                                                   | STATUS CONTACTS FOR MONITORING                                            | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                     |  |  |
|                                                                                   | INTEGRAL STARTER DISTURBED SIGNAL                                         | REQUIRED (MOTOR THERMOSTAT TRIP/O/L RELAY OPERATED, CONT. /POWER SUPPLY FAILED, S/S IN LOCAL/OFF MODE, TORQUE SWITCH OPEN/CLOSE CUT OFF/STOP PB OPTD.) |  |  |
| <b>INTERPOSING RELAY/OPTO COUPLER</b><br>(Applicable for integral Starter)        | TYPE OF ISOLATING DEVICE                                                  | <input type="checkbox"/> INTERPOSING RELAY <input checked="" type="checkbox"/> OPTO COUPLER<br><input type="checkbox"/> EITHER                         |  |  |
|                                                                                   | QUANTITY                                                                  | <input checked="" type="checkbox"/> 2 NOS. <input type="checkbox"/> 3 NOS.                                                                             |  |  |
|                                                                                   | DRIVING VOLTAGE                                                           | <input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC                                                                  |  |  |
|                                                                                   | DRIVING CURRENT                                                           | <input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX                                                                    |  |  |
|                                                                                   | LOAD RESISTANCE                                                           | <input checked="" type="checkbox"/> > 192 ohms - <25 k ohms<br><input type="checkbox"/> > _____ ohms - < _____ ohms                                    |  |  |
| <b>TORQUE SWITCH</b><br>(Not Applicable for Smart Actuator)<br>(\$\$ Refer Notes) | MFR & MODEL NO.                                                           | BIDDER TO SPECIFY                                                                                                                                      |  |  |
|                                                                                   | OPEN / CLOSE                                                              | <input type="checkbox"/> 1 No. <input checked="" type="checkbox"/> 2Nos.    / <input type="checkbox"/> 1 No. <input checked="" type="checkbox"/> 2Nos  |  |  |
|                                                                                   | CONTACT TYPE                                                              | 2 NO + 2 NC                                                                                                                                            |  |  |
|                                                                                   | RATING                                                                    | 5A 250V AC AND 0.5A 220V DC                                                                                                                            |  |  |
|                                                                                   | CALIBRATED KNOBS(OPEN&CLOSE TS)                                           | REQUIRED FOR SETTING DESIRED TORQUE                                                                                                                    |  |  |
|                                                                                   | ACCURACY                                                                  | +3% OF SET VALUE                                                                                                                                       |  |  |
|                                                                                   |                                                                           |                                                                                                                                                        |  |  |
| <b>LIMIT SWITCH</b><br>(Not Applicable for Smart Actuator) (\$\$ Refer Notes)     | MFR & MODEL NO.                                                           | BIDDER TO SPECIFY                                                                                                                                      |  |  |
|                                                                                   | OPEN : INT : CLOSE                                                        | <input checked="" type="checkbox"/> 2 Nos.                      2 nos(adj)                      1 No. <input checked="" type="checkbox"/> 2Nos.        |  |  |
|                                                                                   | CONTACT TYPE                                                              | 2 NO + 2 NC                                                                                                                                            |  |  |
|                                                                                   | RATING (AC / DC)                                                          | 5A 250V AC AND 0.5A 220V DC                                                                                                                            |  |  |

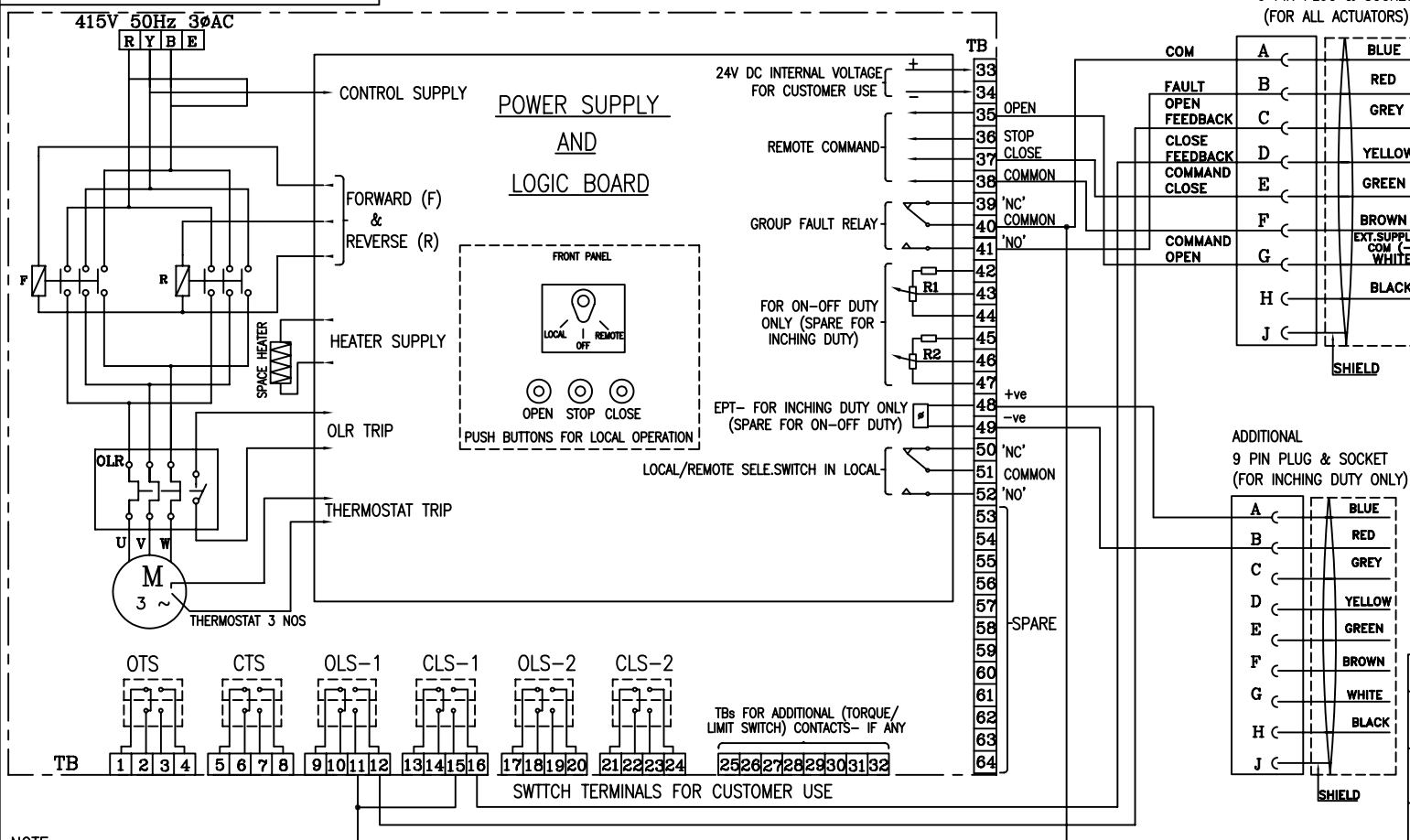
|                                                                                   |                                                           |                    |                                             |                |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|--------------------|---------------------------------------------|----------------|
|  | <b>SPECIFICATION<br/>FOR<br/>MOTORISED VALVE ACTUATOR</b> | SPECIFICATION NO.: |                                             |                |
|                                                                                   |                                                           | VOLUME             | II B                                        |                |
|                                                                                   |                                                           | SECTION            | D                                           |                |
|                                                                                   |                                                           | REV. NO.           | 00                                          | DATE: 26.02.18 |
|                                                                                   |                                                           | SHEET              | 3                                           | OF 4           |
| <b>Data Sheet A &amp; B</b>                                                       |                                                           |                    |                                             |                |
| DATA SHEET-A<br>(TO BE FILLED BY PURCHASER)                                       |                                                           |                    | DATA SHEET-B<br>(TO BE FILLED-UP BY BIDDER) |                |

|                             |                                                                       |                                                                                                                                                                 |  |
|-----------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>POSITION TRANSMITTER</b> | POSITION TRANSMITTER (For inching duty & other specific applications) | REQUIRED for regulating/inching duty only.                                                                                                                      |  |
|                             | MFR & MODEL NO.                                                       | BIDDER TO SPECIFY                                                                                                                                               |  |
|                             | TYPE                                                                  | <input type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER<br><input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) contactless inductive type                |  |
|                             | SUPPLY                                                                | <input checked="" type="checkbox"/> 24V DC <input type="checkbox"/> .....                                                                                       |  |
|                             | OUTPUT                                                                | <input checked="" type="checkbox"/> 4-20mA                                                                                                                      |  |
|                             | ACCURACY                                                              | $\pm 1\%$ FS                                                                                                                                                    |  |
| <b>SPACE HEATER</b>         | @SPACE HEATER                                                         | REQUIRED                                                                                                                                                        |  |
|                             | @ POWER SUPPLY (NON INTEGRAL)                                         | 230V AC,1 PH.,50 Hz                                                                                                                                             |  |
|                             | @ POWER SUPPLY (INTEGRAL)                                             | BIDDER TO SPECIFY                                                                                                                                               |  |
|                             | @ RATING                                                              |                                                                                                                                                                 |  |
| <b>TERMINAL BOX</b>         | ACTUATOR/MOTOR TERMINAL BOX                                           | REQUIRED                                                                                                                                                        |  |
|                             | ENCL CLASS ACTUATOR/MOTOR T.B.                                        | @ <input checked="" type="checkbox"/> IP 68                      @ <input type="checkbox"/> NEMA6                                                               |  |
|                             | @ EARTHING TERMINAL                                                   | REQUIRED                                                                                                                                                        |  |
|                             | PLUG & SOCKET(9 PIN)<br>(FOR COMMD, LS/TS FEED BACK, PoT)             | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED<br><input checked="" type="checkbox"/> 2 NOS. <input type="checkbox"/> ..... |  |
| <b>CABLE GLANDS</b>         | @ POWER CABLE GLAND                                                   | SIZE:-----                                                                                                                                                      |  |
|                             | @ SPACE HEATER CABLE GLAND                                            | SIZE:-----                                                                                                                                                      |  |
|                             | OTHER CONTROL CABLE GLANDS-1                                          | <input type="checkbox"/> 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)                                                                                          |  |
|                             | OTHER CONTROL CABLE GLANDS-2                                          | 1 no suitable for 8P X 0.5 sq mm<br>Additional 1 no suitable for 2P X 0.5 sq mm(inching duty only)                                                              |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                           |                   |                                             |                |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>SPECIFICATION<br/>FOR<br/>MOTORISED VALVE ACTUATOR</b> |                   | SPECIFICATION NO.:                          |                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                           |                   | VOLUME II B                                 |                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                           |                   | SECTION D                                   |                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                           |                   | REV. NO. 00                                 | DATE: 26.02.18 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                           |                   | SHEET 4                                     | OF 4           |
| <b>Data Sheet A &amp; B</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                           |                   |                                             |                |
| DATA SHEET-A<br>(TO BE FILLED BY PURCHASER)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                           |                   | DATA SHEET-B<br>(TO BE FILLED-UP BY BIDDER) |                |
| <b>WEIGHT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | TOTAL WEIGHT (ACTUATOR + ACCESSORIES)                     | BIDDER TO SPECIFY | _____ Kg.                                   |                |
| <b>NOTES:</b> <ol style="list-style-type: none"> <li><b>SCOPE:</b> DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.</li> <li><b>CODES &amp; STANDARDS:</b> DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722</li> <li>TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.</li> <li>CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.</li> <li>THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.</li> <li>THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE &amp; FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.</li> <li>THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.</li> </ol> <p><b>\$\$ TORQUE SWITCH &amp; LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.</b></p> <p><b>## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.</b></p> <ol style="list-style-type: none"> <li>IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.</li> <li>POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL</li> <li>WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM.</li> <li>THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE AND RUNNING AT 80 PERCENT OF RATED VOLTAGE AT RATED TORQUE AND 85 PERCENT RATED VOLTAGE AT 33 PERCENT EXCESS RATED TORQUE FOR A PERIOD OF 5 MINUTES EACH.</li> <li>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.</li> <li>ALL SIX (6) LIMIT SWITCHES SHALL BE CHANGEOVER TYPE AND ADJUSTABLE BESIDES HAVING THE SNAP FACILITY.</li> <li>THE INTEGRAL STARTER WHICH SHALL HAVE SOPHISTICATED ELECTRONIC CONTROLS WITH FIELD PROGRAMMING FEATURE. IT SHALL BE DESIGNED FOR REMOTE CONTROL FROM DCS/RESPECTIVE CONTROL SYSTEM. REQUIRED INTERPOSING RELAYS FOR RECEIVING OPEN/CLOSE/STOP COMMAND FROM DCS/RESPECTIVE CONTROL SYSTEM SHALL BE PROVIDED. POTENTIAL FREE CONTACTS AND TRANSDUCERS SHALL BE PROVIDED TO PROVIDE STATUS INDICATION AT REMOTE DCS/RESPECTIVE CONTROL SYSTEM.</li> <li>THE REMOTE COMMAND SIGNAL (OPEN-STOP-CLOSE) FROM DCS/RESPECTIVE CONTROL SYSTEM/CONTROL PANEL SHALL BE ISOLATED FROM CONTROL ELECTRONICS THROUGH OPTO-ISOLATOR.</li> <li>THE FOLLOWING INDIVIDUAL STATUS ANNUNCIATION LED'S (COLOUR-GREEN) SHALL BE PROVIDED LOCALLY (INTEGRAL TO ACTUATOR) TO ANNUNCIATE THE FOLLOWING FOR EASY LOCAL MONITORING.<br/>           ACTUATOR IN LOCAL MODE<br/>           ACTUATOR IN REMOTE MODE<br/>           ACTUATOR RUNNING IN OPEN DIRECTION<br/>           ACTUATOR RUNNING IN CLOSE DIRECTION<br/>           ACTUATOR IN INCHING MODE.<br/>           ACTUATOR IN SELF-RETAINING MODE<br/>           LIMIT SWITCH OPEN TRIP<br/>           LIMIT SWITCH CLOSE TRIP<br/>           CONTROL VOLTAGE AVAILABILITY         </li> </ol> |                                                           |                   |                                             |                |
| <b>NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ELECTRICAL</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                           |                   |                                             |                |

3-V-MISC-24283

DRAWING NO.



## CONTACT DEVELOPMENT DIAGRAM

|                                                                                                                   |              |                                            |   |              |   |            |
|-------------------------------------------------------------------------------------------------------------------|--------------|--------------------------------------------|---|--------------|---|------------|
| OTS                                                                                                               | 1-2          | OPEN AT OVER TORQUE DURING OPENING TRAVEL  |   |              |   |            |
|                                                                                                                   | 3-4          | CLOSE AT OVER TORQUE DURING OPENING TRAVEL |   |              |   |            |
| CTS                                                                                                               | 5-6          | OPEN AT OVER TORQUE DURING CLOSING TRAVEL  |   |              |   |            |
|                                                                                                                   | 7-8          | CLOSE AT OVER TORQUE DURING CLOSING TRAVEL |   |              |   |            |
| OLS-1                                                                                                             | 9-10         |                                            |   |              |   |            |
|                                                                                                                   | 11-12        |                                            |   |              |   |            |
| CLS-1                                                                                                             | 13-14        |                                            |   |              |   |            |
|                                                                                                                   | 15-16        |                                            |   |              |   |            |
| OLS-2                                                                                                             | 17-18        |                                            |   |              |   |            |
|                                                                                                                   | 19-20        |                                            |   |              |   |            |
| CLS-2                                                                                                             | 21-22        |                                            |   |              |   |            |
|                                                                                                                   | 23-24        |                                            |   |              |   |            |
| SWITCH                                                                                                            | TERMINAL NO. | FULL OPEN                                  | a | INTERMEDIATE | b | FULL CLOSE |
|                                                                                                                   |              | VALVE POSITION                             |   |              |   |            |
| <div><div></div><div>INDICATES CONTACT CLOSED</div></div> <div><div></div><div>INDICATES CONTACT OPEN</div></div> |              |                                            |   |              |   |            |
| CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC                                                                   |              |                                            |   |              |   |            |

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

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

## SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

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

NOTE:-

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

| REV | DATE | ALTERED    |
|-----|------|------------|
|     |      | CHD & APPD |

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TYPE OF PRODUCT  
OR NAME OF  
CUSTOMER/PROJECT

ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS  
FOR NTPC PROJECTS  
(DRAWN FOR INTERMEDIATE POSITION OF VALVES)



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

DEPT  
VL  
CODE

SCALE  
NTS

WEIGHT (KG).  
-

REFERENCE INFORMATION

TITLE  
WIRING DIAGRAM (TERMINAL PLAN)  
FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET  
FOR NTPC PROJECTS

CARD  
CODE  
U 01

DRAWING NO.  
3-V-MISC-24283  
REV  
0



Technical specification  
for  
**1X660 MW TPS PANKI EXTN.**

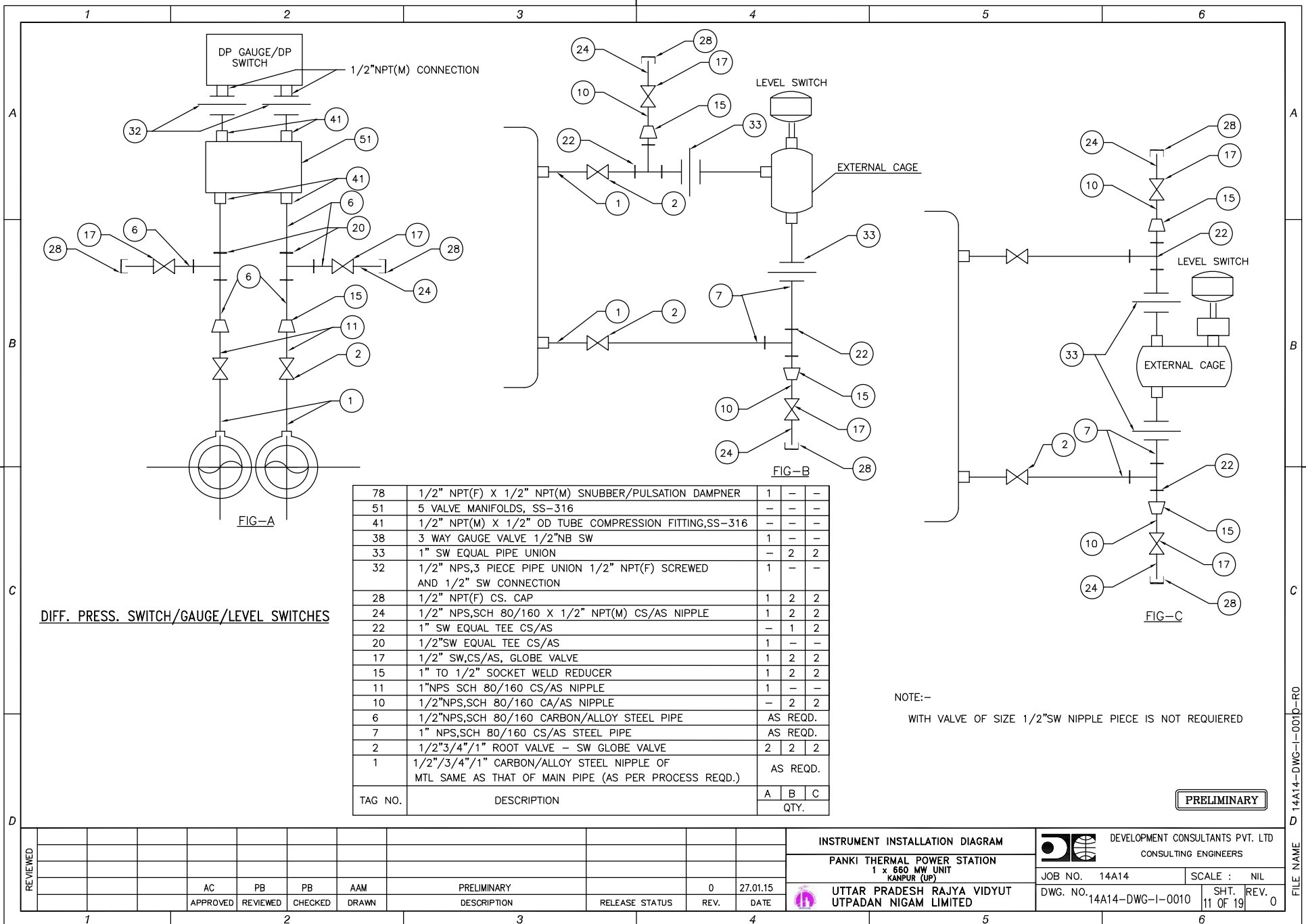
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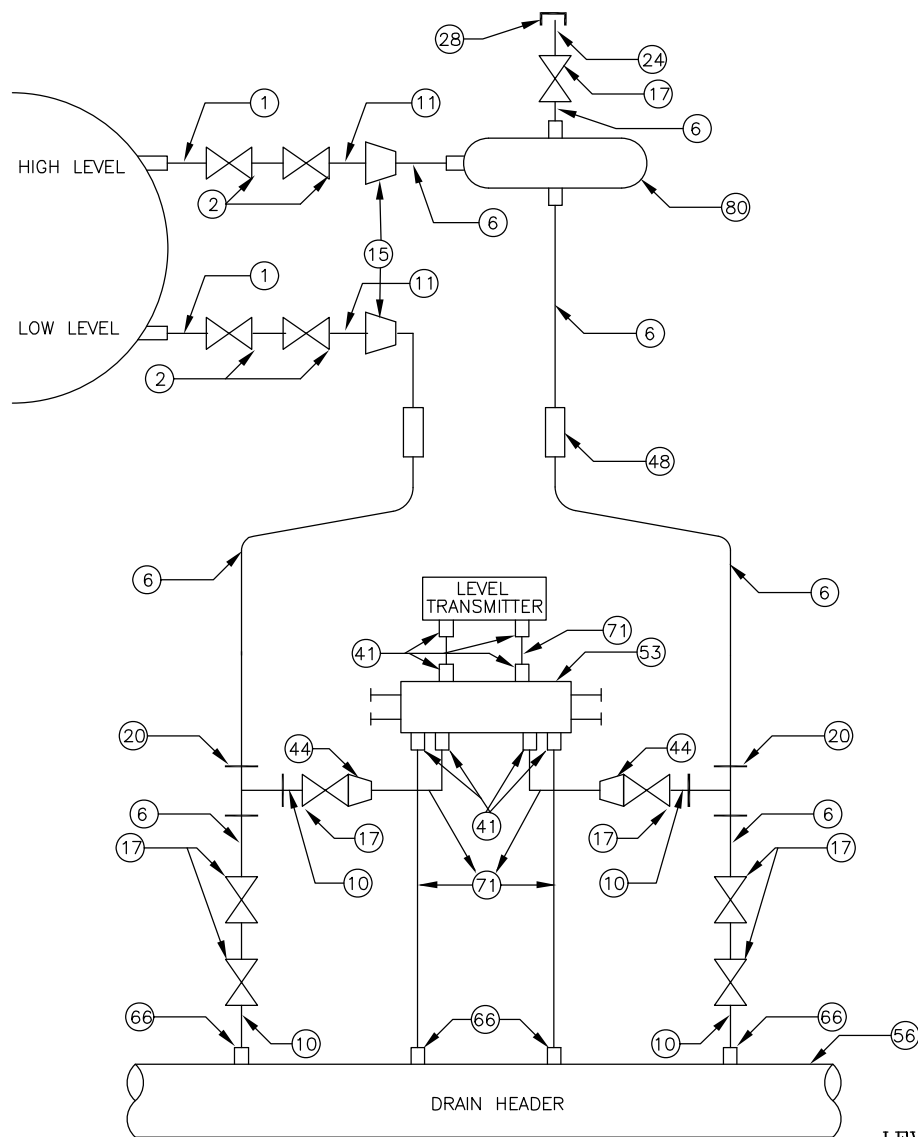
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DATE : 20.07.2019

# **INSTRUMENT INSTALLATION DIAGRAM**







|         |                                                                                        |          |
|---------|----------------------------------------------------------------------------------------|----------|
| 80      | CONDENSATION CHAMBER                                                                   | 1        |
| 71      | 1/2"OD IMPULSE TUBE, SS-316                                                            | AS REQD. |
| 66      | 1/2" GI SOCKET / FUNNEL                                                                | 4        |
| 56      | 2"NB GI DRAIN HEADER                                                                   | AS REQD. |
| 53      | 5-VALVE MANIFOLD, SS-316                                                               | 1        |
| 48      | 1/2" SW, CS/AS BULK HEAD PIPE UNION                                                    | 2        |
| 44      | 1/2"BWx1/2"OD COMPRESSION TUBE FITTING,SS-316                                          | 2        |
| 41      | 1/2"NPT(M)x1/2"OD TUBE COMPRESSION FITTING,SS-316                                      | 8        |
| 28      | 1/2" NPT (F) CS CAP                                                                    | 1        |
| 24      | 1/2" NPS SCH-80/160x1/2"NPT(M) CS/AS NIPPLE                                            | 1        |
| 20      | 1/2" SOCKET WELDED EQUAL TEE CS/AS                                                     | 2        |
| 17      | 1/2" SOCKET WELDED CS GLOBE VALVE                                                      | 7        |
| 15      | 1"TO 1/2" SOCKET WELD REDUCER                                                          | 2        |
| 11      | 1" NPS SCH 80/160 CS/AS NIPPLE                                                         | 2        |
| 10      | 1/2" NPS SCH 80/160,CS/AS NIPPLE                                                       | 4        |
| 6       | 1/2" NPS SCH 80/160 CS/AS PIPE                                                         | AS REQD. |
| 2       | 1/2"/3/4"/1" SOCKET WELDED GLOBE VLV/ROOT VLV.                                         | 4        |
| 1       | 1/2" NPS SCH 80 NIPPLES OF MATERIAL SAME AS MAIN PIPE WITH NECESSARY ATTACH TO FLANGES | AS REQD. |
| TAG NO. | DESCRIPTION                                                                            | BOM      |

NOTE:-

- FOR HIGH TEMP. SERVICE (MORE THAN 80°C)  
A 'U' TUBE(REF. SH-2 OF 19) SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER
- FOR HIGH PR.(MORE THAN 40kg/sqcm) ONE NO. OF ISOLATING VLV. IS PROVIDED IN EACH LINE BETWEEN VLV. MANIFOLD AND 1/2"SW EQUAL TEE AND 2NO. DRAIN VLV. ARE ALSO

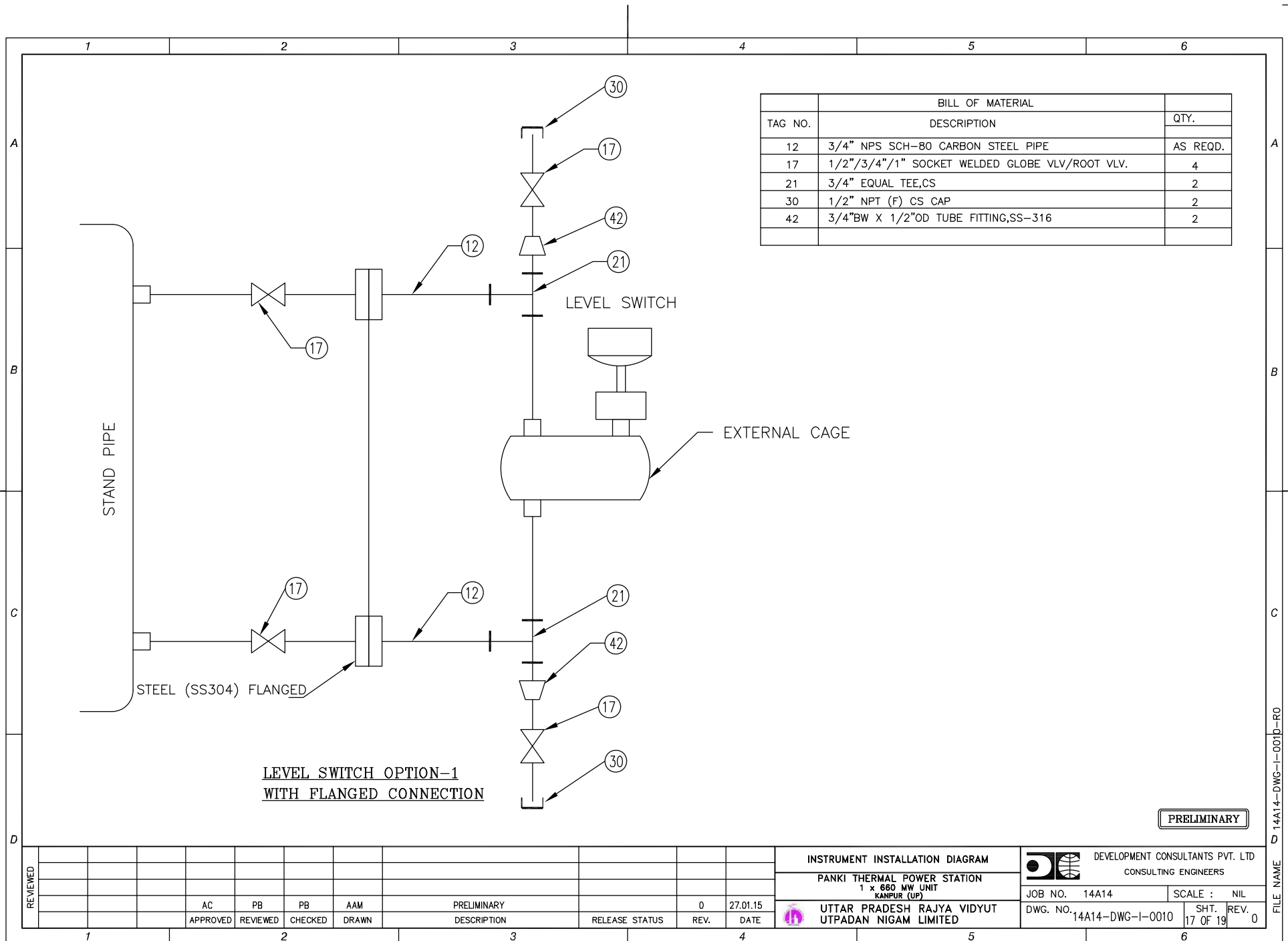
LEVEL TRANSMITTERS

TRANSMITTER MOUNTED BELOW INST. SOURCE POINT

PRELIMINARY

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FILE NAME D 14A14-DWG-I-0010-R0









Technical specification  
for  
**1X660 MW TPS PANKI EXTN.**

REV. NO.

00

DATE : 20.07.2019

# LOCAL CONTROL PANEL SPECIFICATION

- xi. Bidder shall provide Ammeters on control panel/desk for all HT motor current and important LT motor  $\geq 30$  KW & other important drives and voltmeter for LT bus voltage.

**14.24.00****RELAY BASED LOCAL CONTROL PANEL / DESK**

Local control panel shall be of 2.5 mm steel construction, free standing type, totally enclosed dust and vermin proof with enclosure protection class of IP-65 as per IS: 13947 and colour shall be as per shade no. RAL 7032/7035. One uniform colour shade as finalized during detailed engineering shall be applicable for complete plant.

Panel shall be mounted on vibration dampers secured to steel frame on to the floor. Equipment and relays mounted on the panel shall be easily accessible. The panel shall be supplied completely wired upto terminal blocks for connecting external cables entering the panel from the bottom. Blank removable gland plate shall be provided with double compression type cable glands/conduits knockout along with the panel.

Terminal block shall be rated 650 volts grade, 10 Amps rated minimum made up of unbreakable polyamide 6.6 grade and shall have strap cage clamp type screw less terminals suitable for connection with 2x2.5 sq mm copper conductors on each side. Terminal block shall be provided with white marking strips. All metal parts shall be of non-ferrous material. The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks. The minimum clearance between the first row of terminal blocks and the associated cable gland plate shall be 250 mm. Fuses shall not be mounted on terminal blocks. At least 20 percent spare unused terminals fully wired shall be provided on terminal block.

Contactors, Relays, timers and other devices mounted on the panel shall have clearly visible identification marking. Separate contactors shall be provided for start & stop command. Common contactor for start & stop command are not acceptable. All fuses shall be HRC semiconductor type of AC supply. HRC link & fuse shall be of removable type having 45 kA rupturing capacity (min) for protection of various circuits.

The panel shall be provided with a 50x6 mm tinned copper earthing strip running throughout the length of the panel at the bottom. Panel shall be provided with space heaters with isolating DPN MCB, and thermostats. LED based lamps illuminating lights, complete with door switches; and 1 no. 6 pin 6/16 amps sockets with DPN MCB.

Panel shall be provided with fluorescent illuminating lamps with door switch and 6 point 6/16A, 230V AC socket with switch for maintenance purposes. Panel shall have removable lifting eye bolts for safe lifting from top during handling. Control power supply shall be provided from dual redundant feeders with auto change over scheme, surge protection devices and Power/Volt/AM meter.

The panel shall be provided with push buttons, indicating lamps, annunciators, indicating instruments, interlock/ deinterlock switches etc., required for the complete system. General details as specified in Vol. V, chapter 6 shall also be referred for engineering and design of relay panel/desk.

Coloured Mimic with 6/7 mm thickness sheet for respective plant lay out shall be provided as specified in Annexure A, control system philosophy.

20% spare relays of each type and rating shall be mounted and wired in relays control panel/Desk. All contacts of relays shall be terminated in terminal blocks of relay control panel/Desk, Additionally in the relay control panel/Desk, 20% spare wired terminal blocks shall be 'provided so that additional relays can be mounted and wired.

The annunciation system shall consist of panel mounted audio-visual windows of 50x75 mm provided with plug-in-type solid-state logic 16 nos. high intensity LEDs in parallel. EACH relay based control panel shall be provided with 30 nos min. facia windows. Initiating contacts may be either NO or NC; a jumper or switch shall be provided in each card to make it suitable for either type of contact. A set of acknowledge, reset and test push buttons shall be provided on the panel. All printed circuit boards shall be of epoxy fiber glass construction.

The sequence of annunciation shall be as follows:

|    | Condition          | Visual    | Audible   |
|----|--------------------|-----------|-----------|
|    | Normal             | OFF       | OFF       |
|    | Alarm              | Flashing  | ON        |
|    | Acknowledge        | Steady    | OFF       |
|    | Return to Normal:  |           |           |
| a. | Before acknowledge | Flashing  | ON        |
| b. | After acknowledge  | Steady    | OFF       |
|    | Reset:             |           |           |
| a. | Alarm condition    | No change | No change |
| b. | Return to normal   | OFF       | OFF       |

14.25.00

**LOCAL CONTROL PANEL (Protection class as per cl. No. 1.07.00, vol V, Part B, Ch-1)**

Local control panels provided anywhere in the plant shall be totally enclosed, Dust tight and Vermin proof having IP-65 protection. It shall be fabricated of 3 mm CRCA sheet. Panel should be floor mounted, compartmentalized, hinged door for access to compartment. It shall have switches, push buttons, LED clustered type indicating lights, indicating instruments and HW annunciation etc. and sufficient number of panel space heater along with thermostat and 5/15A receptacles. In General Local control panel shall comply the features as specified in Vol. V, chapter 6.



**6.10.00 CONSTRUCTIONAL FEATURES OF LOCAL CONTROL PANELS, CONSOLES, CONTROL Desk, CUBICLES & ENCLOSURES**

- i. All control panels, cubicles, consoles, SOV panels and enclosures provided anywhere for subject plant per this specification shall be of free standing type and shall be constructed of specified gauge of steel plates (CRCA). The minimum sheet thickness of panels shall be as follows unless otherwise specified herein.

Side and top – not less than 1.6 mm

Door – not less than 2.0 mm

Mounting plate – 2.5 mm

Base metal plate - 2.5 mm

Gland plate – 3 mm

- ii. The panels, consoles/desks shall be reinforced as required to ensure true surfaces and adequate support for instruments mounted thereon. All instrument cutouts, mounting studs, and support brackets shall be accurately located. All welds on the exposed panel surfaces shall be ground smooth. Finished panel surfaces shall be free from waves, bellies, or other imperfections. Unless specified, otherwise, panel doors shall be 4 points hinged and shall have turned back edges and additional bracing where required to ensure rigidity. Door hinges shall be of the concealed type. Door latches shall be of the three/four -point type to ensure tight closing. Door locks shall be furnished which will allow actuation of all locks by a single master key. All panels shall have removable lifting eyebolts for safe lifting from top during storage and installation handling.

Cabinet doors shall be hinged and shall have turned back edges and additional bracing where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three/four -point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is equal or more than 800 mm, double doors shall be provided.

- iii. All panels shall be mounted on vibration dampers, which are secured to C-channels mounted on the floor. The channels shall be field welded to steel plates set into the concrete flooring. The steel plates shall be located such as to approximate the outline of panel bases. The exact mounting details shall be as approved by the owner during detailed engineering stage. All panels shall be provided with adequate ventilation and packaging density of components shall be restricted so as to limit the temperature rise above ambient to 10°C under the worst conditions. All panels shall have auto on/off switch for internal lighting. All the power supply circuit for control panels shall be provided with auto changeover circuitry.
- iv. In each panel /cabinet, a 24 VDC Voltmeter digital type shall be provided to check the Field Interrogation voltage.
- v. Exhaust Fans with louvers & filters shall be provided on upper side to remove hot air in all consoles and panels.
- vi. Fire & Smoke detectors shall be provided inside the Control room mounted system/control cabinets.
- vii. Feeder failure/ healthy indication shall be provided in each cabinet & remote indication shall be hooked up to DDCMIS/ PLC/annunciation & suitably grouped.
- viii. All the panels shall be equipped with Anti vibration pad of min. 15 mm size thickness. Cable gland plate thickness shall be 3 mm. C Channel height shall be min. 100 mm.
- ix. Doors shall be provided with neoprene/polyurethane gasket only. The front and rear doors shall be of full height .
- x. Protection class shall be as specified at Vol. V, Part B, chapter 1.
- xi. All the cable entries shall be at the bottom of electronic cubicles/control panels.
- xii. Control panels shall be provided with proper arrangement and hardware to terminate the inert gas required for fire protection.
- xiii. 25x6 mm copper ground bus to be provided for each panel/control desk.
- xiv. Terminal blocks shall be Rail mounted 650 V AC grade Terminal blocks (Screw less cage clamp type) with markers and 20% spare wired terminals of each type.
- xv. For Panels/cubicles internal wiring details, Bidder to refer Vol. V, Part B, Chapter 9.

#### **6.11.00 TERMINATION /Marshalling CABINETS & Interposing Relay Panel**

Marshalling/Termination cabinets for the control system shall be supplied for terminating all cables originating from the field, MCC/SWGR or any other source

of signal and for distributing the signals to different functional panels, MCC/SWGR and control cubicles.

Incoming cables from the field, MCC/SWGR or any other source of signal shall be terminated in suitable terminal blocks in logical sequence.

Prefabricated cables with plug in connectors at both ends shall be used for extending the signals to the functional panels. Matching plug sockets shall be provided in the termination cabinets for terminating the plugs.

Interposing relay panels for the system shall be supplied for mounting interposing relays & terminating all cables originating from the DO cards in case of solenoid valves, HW Annunciation windows and other required services etc. IPR panels shall be placed in CER and LCR.

Interposing relay shall be mounted in respective SWGR/MCC/integral starter required for commands signals of HT/LT unidirectional drives and bidirectional drives, breakers, isolators, bus couplers etc from DDCMIS/DCS/PLC or any control system.

Terminal blocks shall be located inside the cabinets on support wings fabricated of metal plates.

The plug socket shall be mounted on hinged plates to provide an access to the rear pins of the plugs.

General features of termination cabinets and accessories shall conform to the general design and construction specification of panels. Terminal blocks shall be Rail mounted 650 V AC grade Terminal blocks (Screw less cage clamp type) with markers and 20% spare wired terminals.

Wiring shall be 650V grade. PVC insulated FRLS stranded copper wire.

#### 6.12.00 SURFACE PREPARATION AND PAINTING

All panel exterior steel surfaces shall be ground smooth, and painted as specified below:

Suitable filler shall be applied to all pits, blemishes and voids in the surfaces. The filler shall be sand blasted so that surfaces are level and flat, corners are smooth and even. Exposed raw metal edges shall be ground burr free. The entire panel surface shall be sand blasted to remove rust and scale and all other residue due to the fabrication operation. Oil grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods. Alternatively 7 tank process shall be followed.

Two spray coats of inhibitive epoxy primer – surface shall be applied to all exterior and interior surfaces, each coat of primer surface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish colour (Catalysed epoxy finish) shall be applied to all surfaces of dry film thickness 2.0 mil. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6



mm. As an alternative, single coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.

The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory applied painted surface of each item of equipment.

The finish colours for exterior and interior surfaces shall conform to the following shades:

- a) Exterior - RAL 7032/RAL 7035.
- b) Interior - Glossy white two coats/RAL 7035 with fire resistant paint

One uniform colour shade as finalized by owner during detailed engineering shall be applicable for complete plant.

Paint films, which show sags, checks, blisters teardrops, fat edges or other painting imperfections, shall not be acceptable and if any such defects appear, they shall be repaired by and at the expenses of the Bidder.

#### **6.13.00 PANEL ILLUMINATION**

Panels shall be provided with LED based illuminating lamps with door switch and six (6) point 5/15A, 240V AC universal type power sockets with switch for maintenance purposes. These switches shall be with quick make and break mechanism. 100 % spare LED lamps shall be provided with each panel, these are in additional to mandatory spares.

#### **6.14.00 Panel Cooling Fans (for ventilation of the DDCMIS/ PLC / DCS & other cabinets)**

Filter Fan for electrical cabinets and enclosures to be used with 120 V or 230 V AC versions having very low acoustic noise and lower power consumption. The fans must have UL approval and should have air flow volume as per the cabinet requirement. Wherever required, the EMC filter fans may be used. Fans should have a life of 50,000 Hours at 40 Deg C. Fan Housing, cover should be of V0 material as per UL94. Filter mat should be compliant to EU3 according to DIN 24185 standard and have a filtering degree of 80 to 90 %. The Ambient temperature range °C should be -10 to +70 Deg C and Protection class should be IP 54. Filter Material shall be Synthetic fibre with progressive construction, temperature resistant to +100°C, self extinguishing, Class F1 as per DIN 53438 standard.

#### **6.15.00 Panel Thermostat (for temperature control of the DDCMIS/PLC/DCS panel – to be connected to switch On/Off Fan/Heater)**

The panel thermostat shall be DIN Rail Mounted with an inbuilt snap action thermostatic bimetal sensor and shall be connected in series with the load without any additional supply voltage. The panel thermostat shall be available in setting temperature range of -20 deg C to 40 deg C or 0 to 60 deg C with separate modules for NO or NC contact. The electrical life at rated load AC1 shall be 1 Lakh switching cycles and shall work at an ambient temperature of -45 to +80 deg C. With AgNi contact material for switching, the contact current carrying

capacity shall be 10 Amp at a rated voltage of 250 V AC with a dielectric strength between open contacts of 500 V AC and shall have UL approval.

#### 6.16.00 FUSES & MCB

All fuses shall be fast acting semiconductor types for AC supply and compatible to the UPS fuses. For all DC Powered devices, similarly the fuses shall be fast acting compatible to DCDB fuse provisions. All the AC power supplies shall be provided with the protection of Fast acting semi conductor fuses & 2 P thermo magnetic type MCB. For all the DC power supply circuits, electronic type DC MCB shall be used only. Make of DC MCB shall be Siemens, Phoenix contacts, Murr, Weidmuller, or Lutze.

50 % spare fuses shall be provided with each panel, these are in additional to mandatory spares.

#### 6.17.00 NAME PLATES AND LABELS

Name plates of adequate size shall be provided for each panel on front and rear of the panel. Instruments/other accessories mounted inside the panels shall have identification marking clearly visible from inside.

Devices to be mounted on the panels shall also be labeled on the panels shall also be labeled on the outside of the panel. Name plates shall be of polyamide sheets with black letters on white background. Name plates shall be attached to the boards by means of stainless steel panhead screws. Fuses provided for protection of various boxes shall be accessible for replacement. Fuse boxes shall be provided with circuit label and fuse rated current and voltage.

##### Markings /Labels

All markers/labels shall be made of halogen & silicon free polyamide material with inflammability class V2 as per UL 94, ensuring scratch proof printing with the use of environment friendly solvent free ink & latest BLUEMARK UV technology so as to comply the WIPE RESISTANCE according to DIN EN 61010-1/VDE 0411-1.

#### 6.18.00 QUANTITIES

Refer Appendix-I to Part-A, Vol.-V of Technical Specifications. Quantities indicated are the minimum requirements, however each & every item shall be provided as per system requirements.

#### 6.19.00 Design Criteria for Control Rooms:

The interiors of the each control Room shall be aesthetically designed with modern designs and technologies. The bidder shall have 2-D and 3-D software for designing the control room layouts. The bidder shall have thorough knowledge on Indian power plant control room requirements. Control rooms shall also be designed as per standard "ISO 11064 (1-7) - Ergonomic design of control centres".



Technical specification  
for  
**1X660 MW TPS PANKI EXTN.**

REV. NO.

00

DATE : 20.07.2019

## **APPLICABLE CABLE TYPES**

| Cable Sizes for 1X660MW TPS PANKI EXTN. |                |
|-----------------------------------------|----------------|
| Sl no.                                  | Cable Type     |
|                                         |                |
| G-TYPE                                  |                |
| 1                                       | 2P X 0.5 sqmm  |
| 2                                       | 4P X 0.5 sq mm |
| 3                                       | 8P X 0.5 sqmm  |
| 4                                       | 12P X 0.5 sqmm |
|                                         |                |
| F-TYPE                                  |                |
| 1                                       | 4P X 0.5 sqmm  |
| 2                                       | 8P X 0.5 sqmm  |
| 3                                       | 12P X 0.5 sqmm |
| 4                                       | 20P X 0.5 sqmm |
|                                         |                |
| CONTROL CABLE                           |                |
| 1                                       | 3C X 2.5 sqmm  |



Technical specification  
for  
1X660 MW TPS PANKI EXTN.

REV. NO.

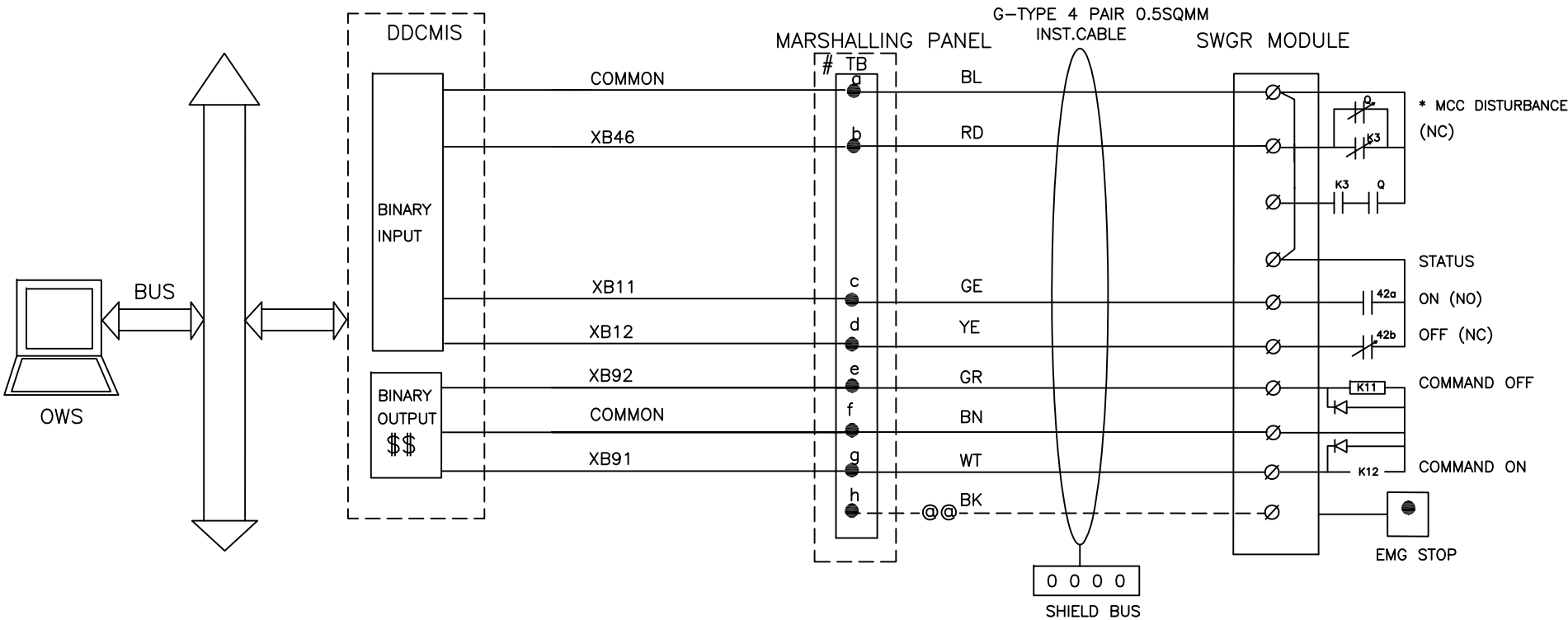
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DATE : 04.04.2019

# DRIVE CONTROL PHILOSOPHY



DDCMIS INTERFACE WITH LT MCC (LT)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

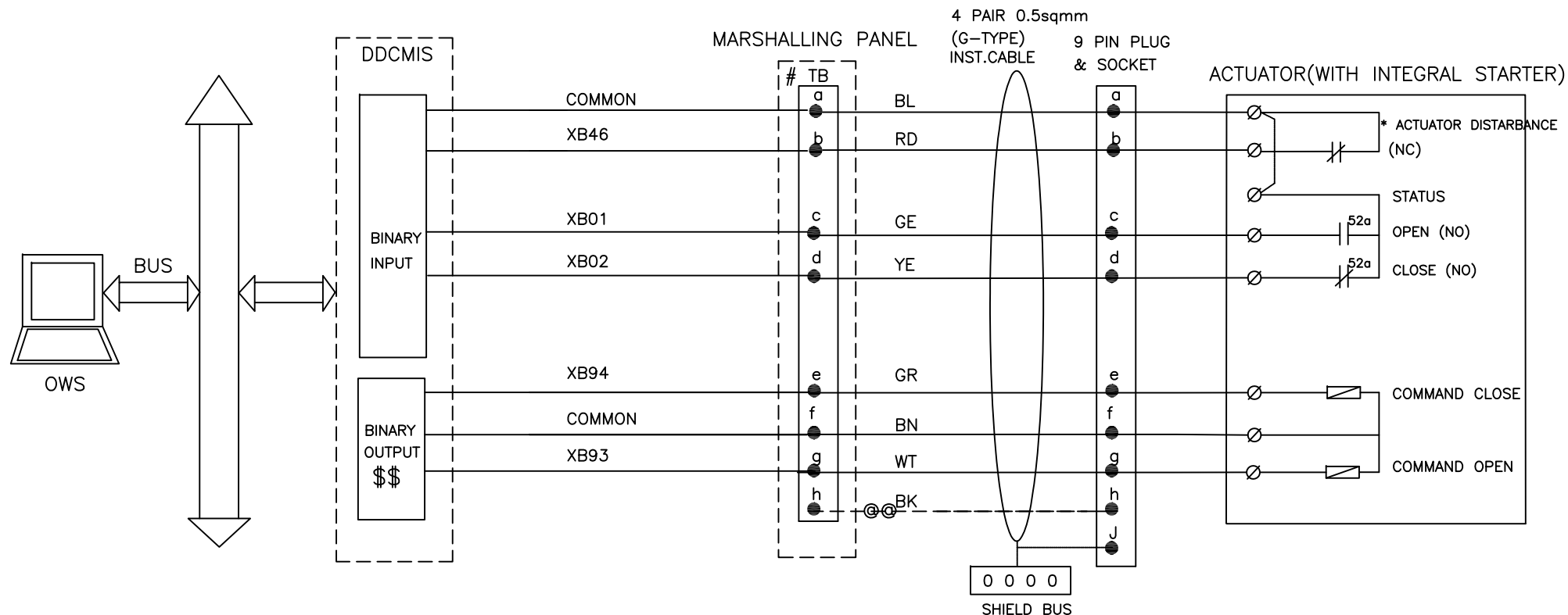
NOTE:-2 # 8 LEVEL TERMINAL BLOCK

NOTE:-3 @@ IN EACH DDCMIS POST, UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION SEQUENTIALLY.

NOTE:-4 \* MCC DISTURBED= THERMAL O/L OPT/CONT SUPP FAIL/EPB OPTD /DRIVE POWER SUPPLY OFF

|                                                                                       |                                                           |         |                           |
|---------------------------------------------------------------------------------------|-----------------------------------------------------------|---------|---------------------------|
|  | UP RAJYA VIDYUT UTPADAN NIGAM LTD<br>1 X 660 MW PANKI TPS | DRG.NO. | 9962-001-PE-405-PVI-B-152 |
|                                                                                       | DDCMIS INTERFACE WITH LT MCC (LT)                         | SHT     | 05 OF 34                  |

DDCMIS INTERFACE WITH BID/MOV/MOD



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

NOTE:-2 # 8 LEVEL TERMINAL BLOCK

NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

NOTE:-4 \* DISTURBANCE=LOSS OF POWER SUPPLY(1PHASE/3PHASE)/LOSS OF CONTROL SUPPLY/MOTOR THERMOSTAT TRIP/THERMAL OVER LOAD/TORQUE SWITCH OPERATED, LOCAL/OFF/REMOTE SWITCH IN LOCAL/OFF POSITION



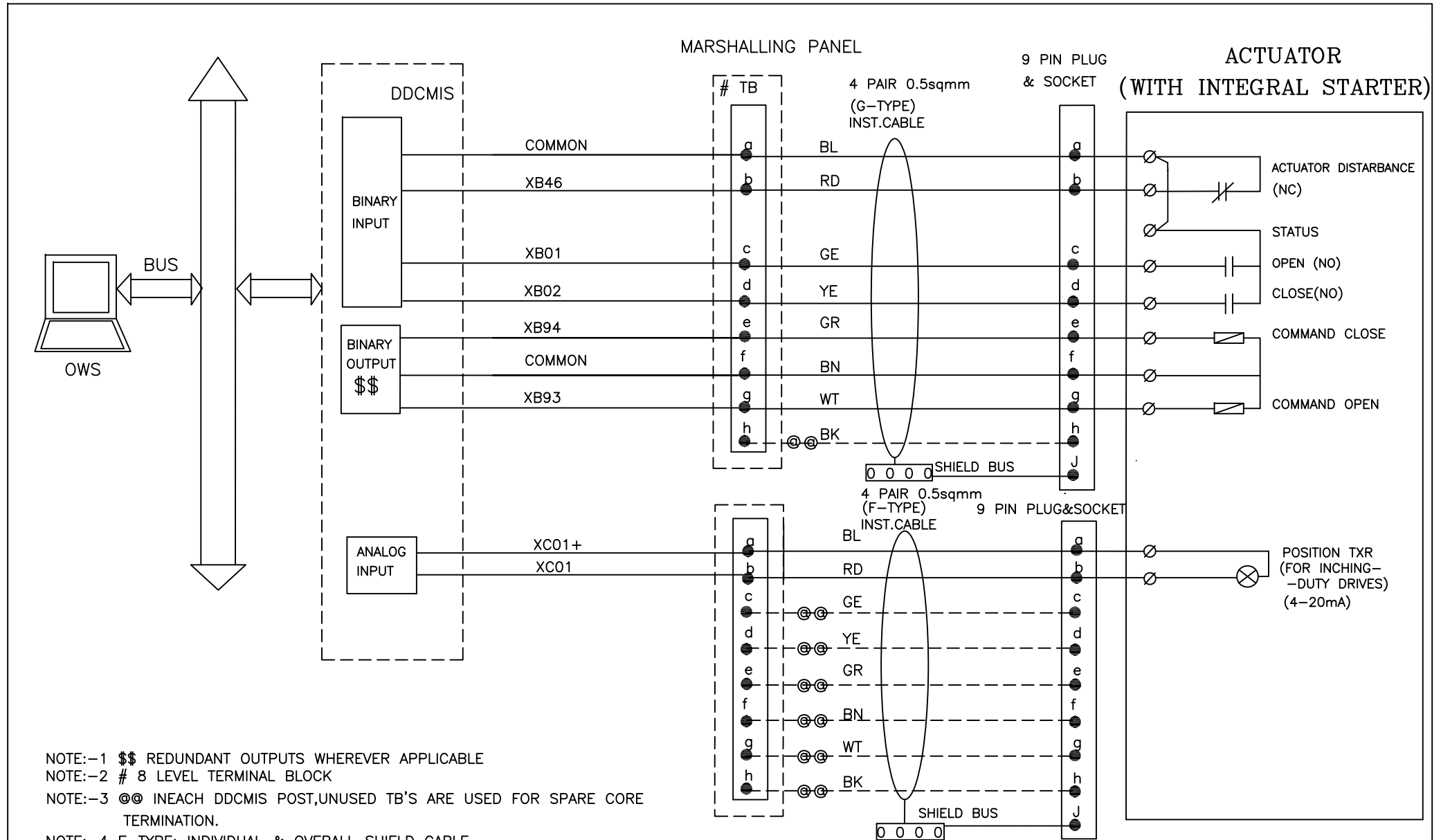
UP RAJYA VIDYUT UTPADAN NIGAM LTD  
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH BID

DRG.NO. 9962-001-PE-405-PVI-B-152

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# DDCMIS INTERFACE WITH BIDI/MODI/MOVI



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

NOTE:-2 # 8 LEVEL TERMINAL BLOCK

NOTE:-3 @@ IN EACH DDCMIS POST, UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

NOTE:-4 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

NOTE:-5 \*DISTURBANCE=LOSS OF POWER SUPPLY/LOSS OF CONTROL SUPPLY/MOTOR THERMOSTAT TRIP/THERMAL OVERLOAD/TORQUE SWITCH OPTD/LOCAL/OFF/REMOTE SWITCH IN LOCAL/OFF POSITION



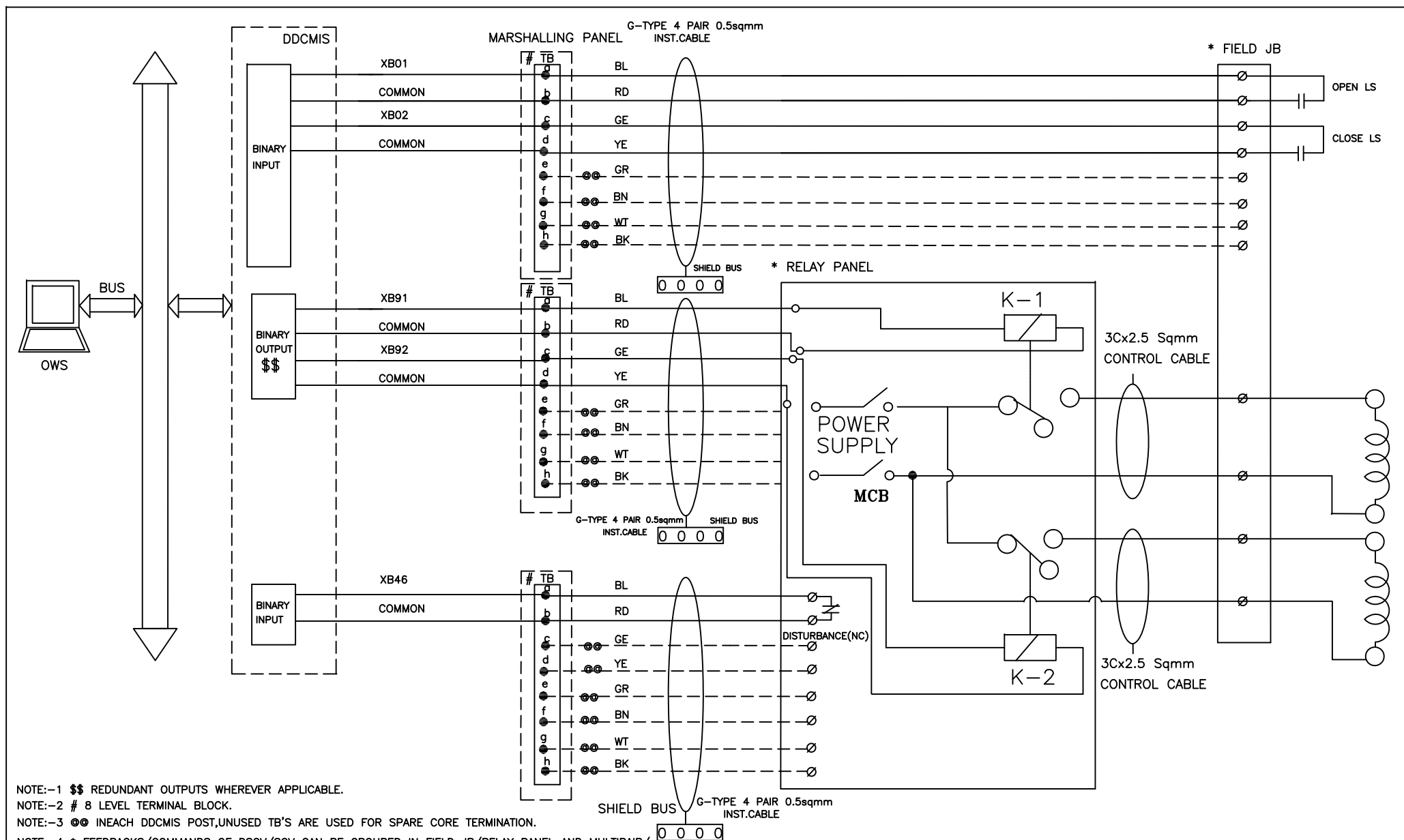
UP RAJYA VIDYUT UTPADAN NIGAM LTD  
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH BIDI

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# DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.

NOTE:-2 # 8 LEVEL TERMINAL BLOCK.

NOTE:-3 ●● IN EACH DDCMIS POST, UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

NOTE:-4 \* FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/  
MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAY PANEL TO MARSHALLING PANEL.

NOTE:-5 FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

NOTE:-6 TWO INDEPENDENT OUTPUT FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE  
VALVES, WITH DUAL COIL SOLENOIDS.



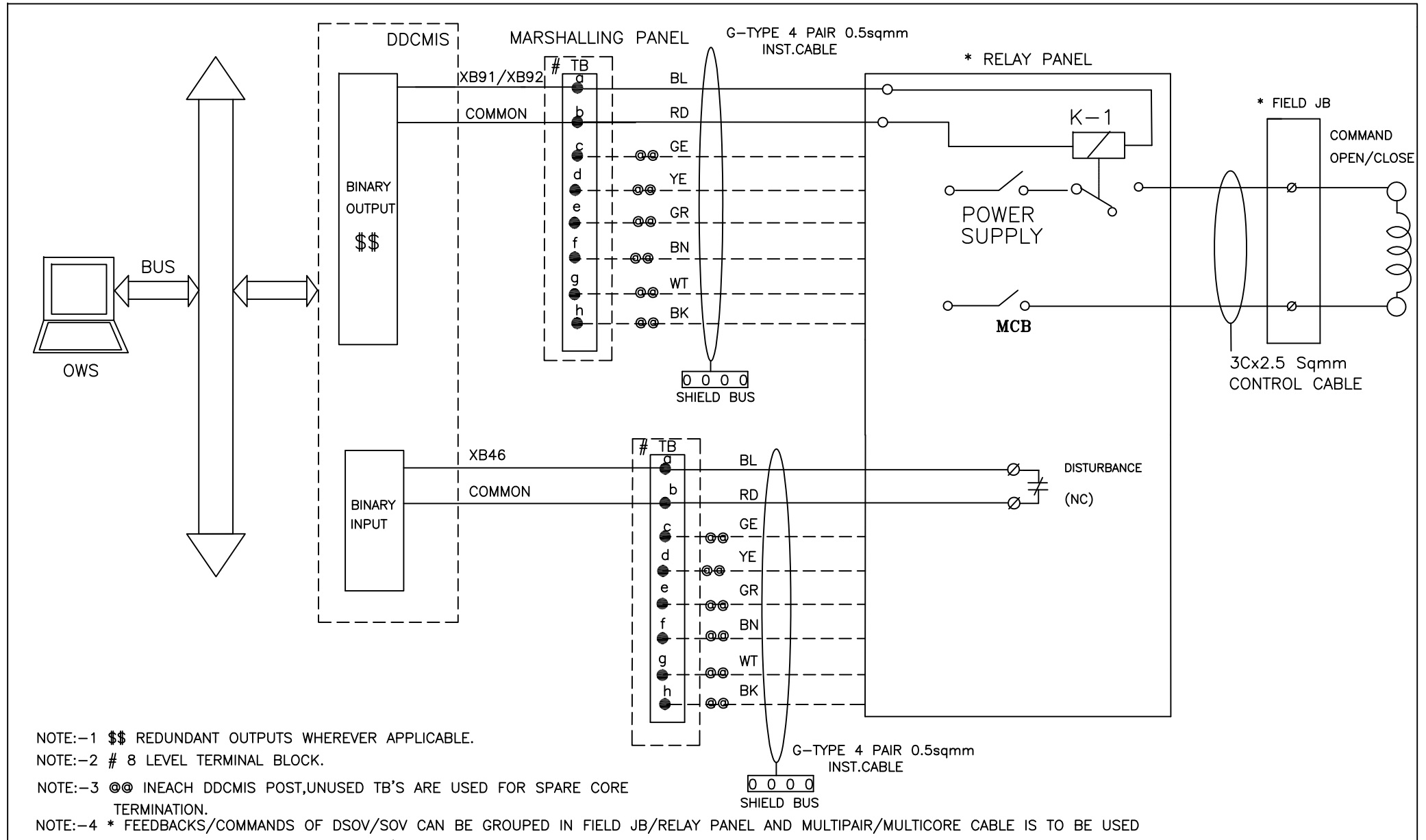
UP RAJYA VIDYUT UTPADAN NIGAM LTD  
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)

DRG.NO. 9962-001-PE-405-PVI-B-152

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# DDCMIS INTERFACE WITH SOV/O/SOV/C(WITH OUT FEEDBACKS)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.

NOTE:-2 # 8 LEVEL TERMINAL BLOCK.

NOTE:-3 @@ IN EACH DDCMIS POST, UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

NOTE:-4 \* FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHELING PANEL.

NOTE:-5 FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.



UP RAJYA VIDYUT UTPADAN NIGAM LTD  
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH  
SOV/O/SOV/C(WITHOUT FEEDBACKS)

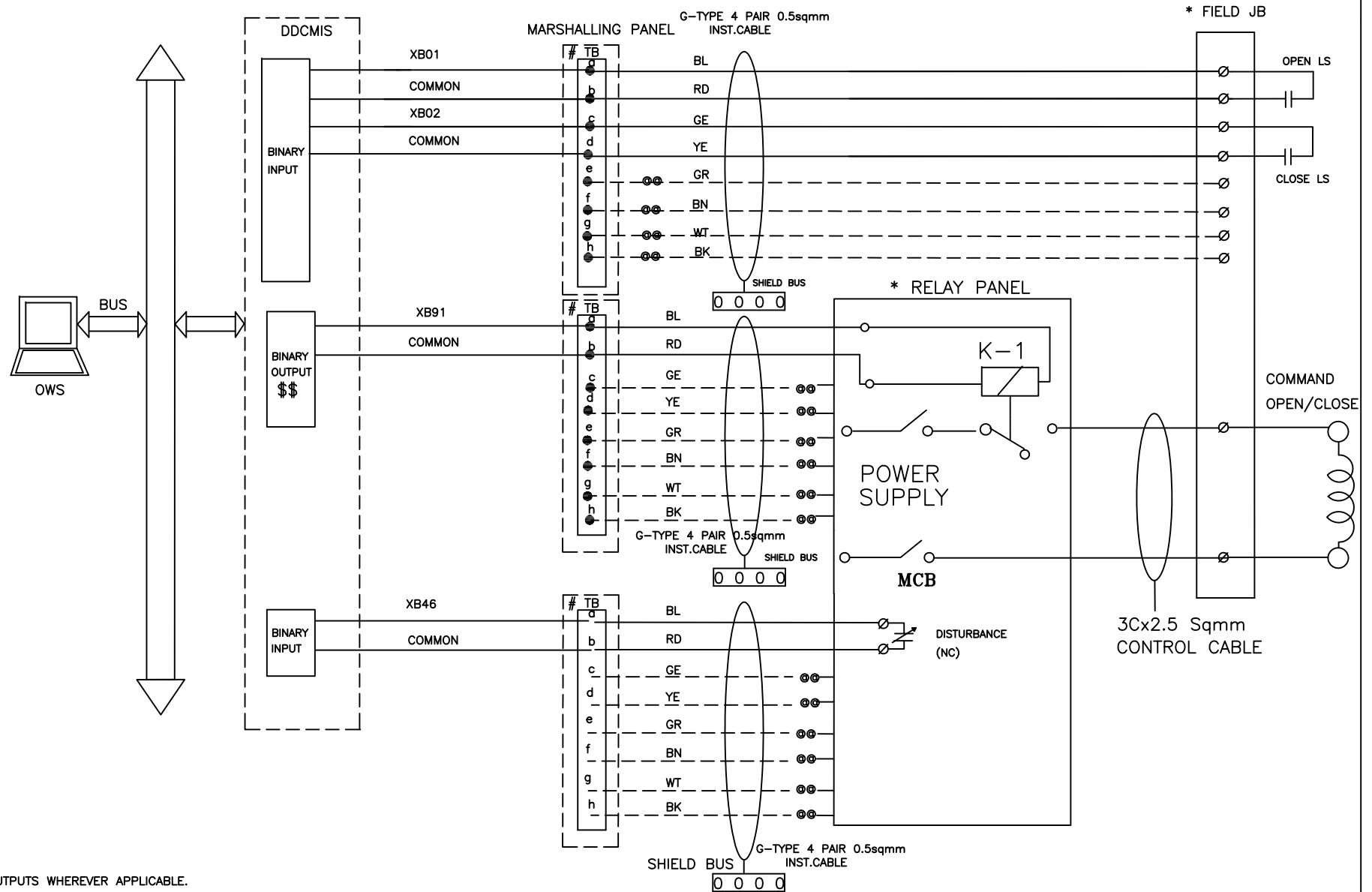
DRG.NO.

9962-001-PE-405-PVI-B-152

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# DDCMIS INTERFACE WITH SOV/O/L(WITH FEED BACKS)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.

NOTE:-2 # 8 LEVEL TERMINAL BLOCK.

NOTE:-3 @ @ IN EACH DDCMIS POST, UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

NOTE:-4 \* FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/  
MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHALING PANEL.

NOTE:-5 FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.



UP RAJYA VIDYUT UTPADAN NIGAM LTD  
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH SOV/O/L(WITH FEEDBACKS)

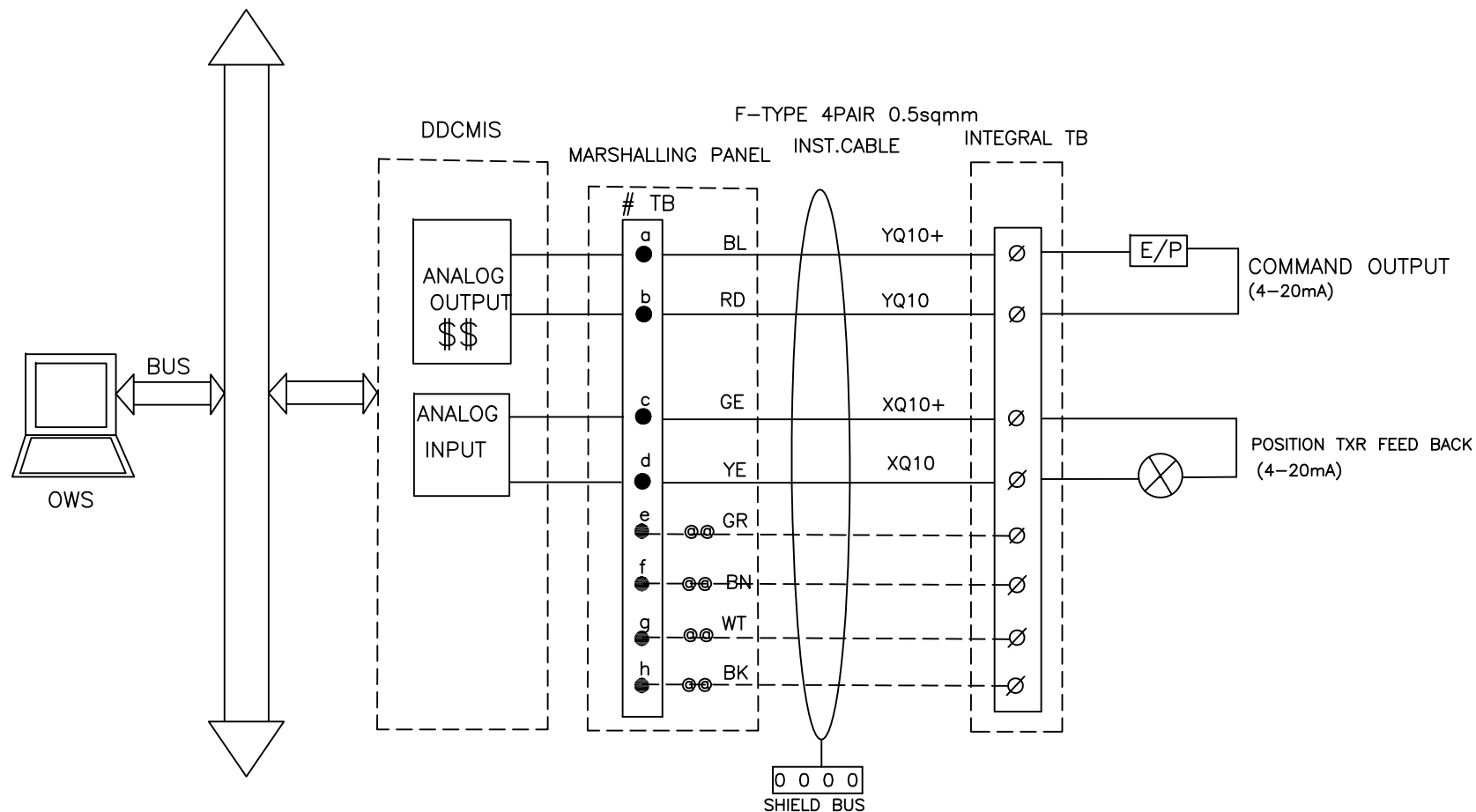
DRG.NO.

9962-001-PE-405-PVI-B-152

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# INTERFACE FOR MODULATING DRIVES – CLCS



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICBLE

NOTE:-2 # 8 LEVEL TERMINAL BLOCK

NOTE:-3 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

NOTE:-4 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.



UP RAJYA VIDYUT UTPADAN NIGAM LTD  
1 X 660 MW PANKI TPS

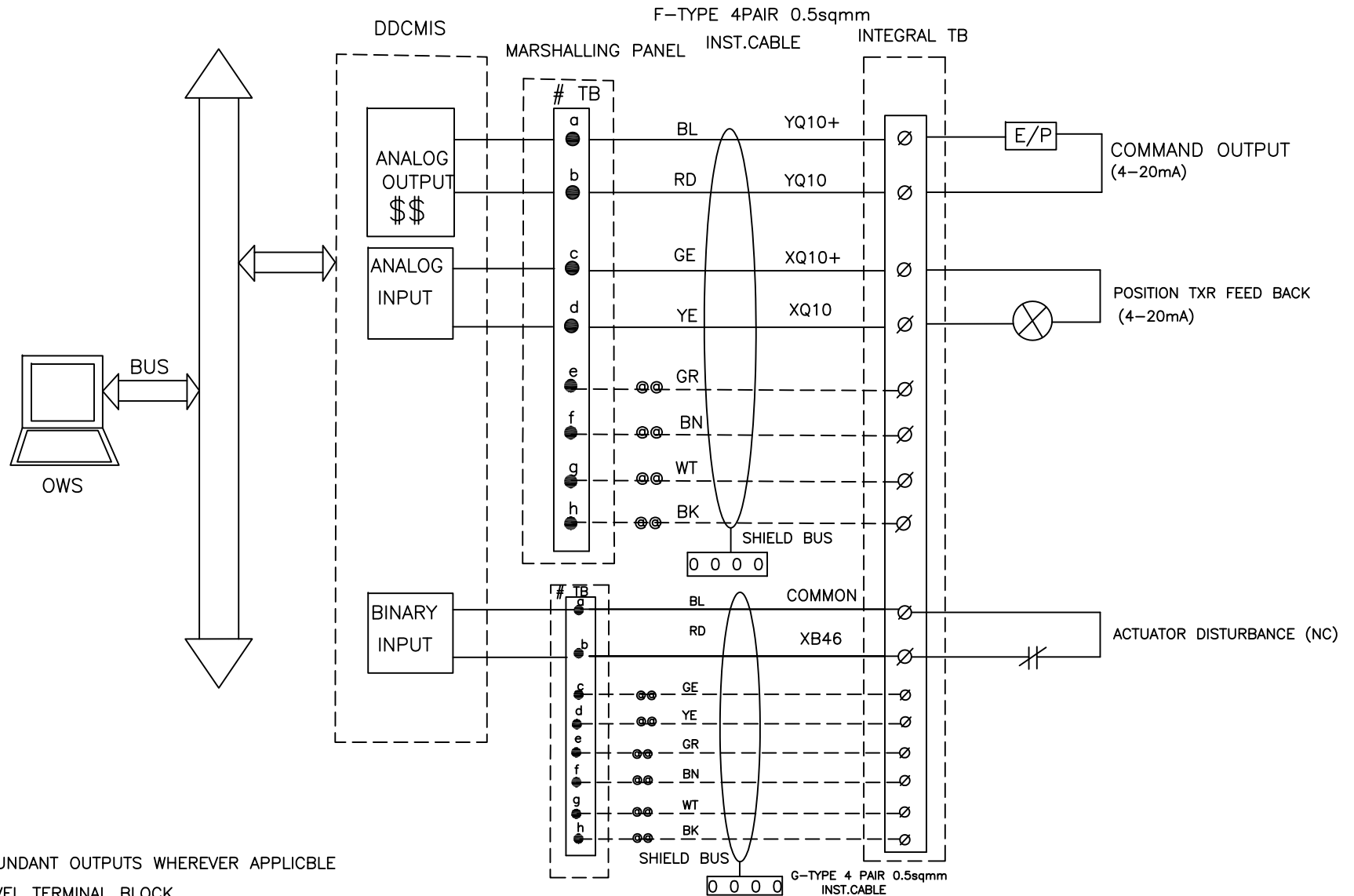
DRG.NO. 9962-001-PE-405-PVI-B-152

INTERFACE FOR MODULATING DRIVES – CLCS

SHT

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# INTERFACE FOR MODULATING DRIVES – CLCS–M



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

NOTE:-2 # 8 LEVEL TERMINAL BLOCK

NOTE:-3 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

NOTE:-4 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.



UP RAJYA VIDYUT UTPADAN NIGAM LTD  
1 X 660 MW PANKI TPS

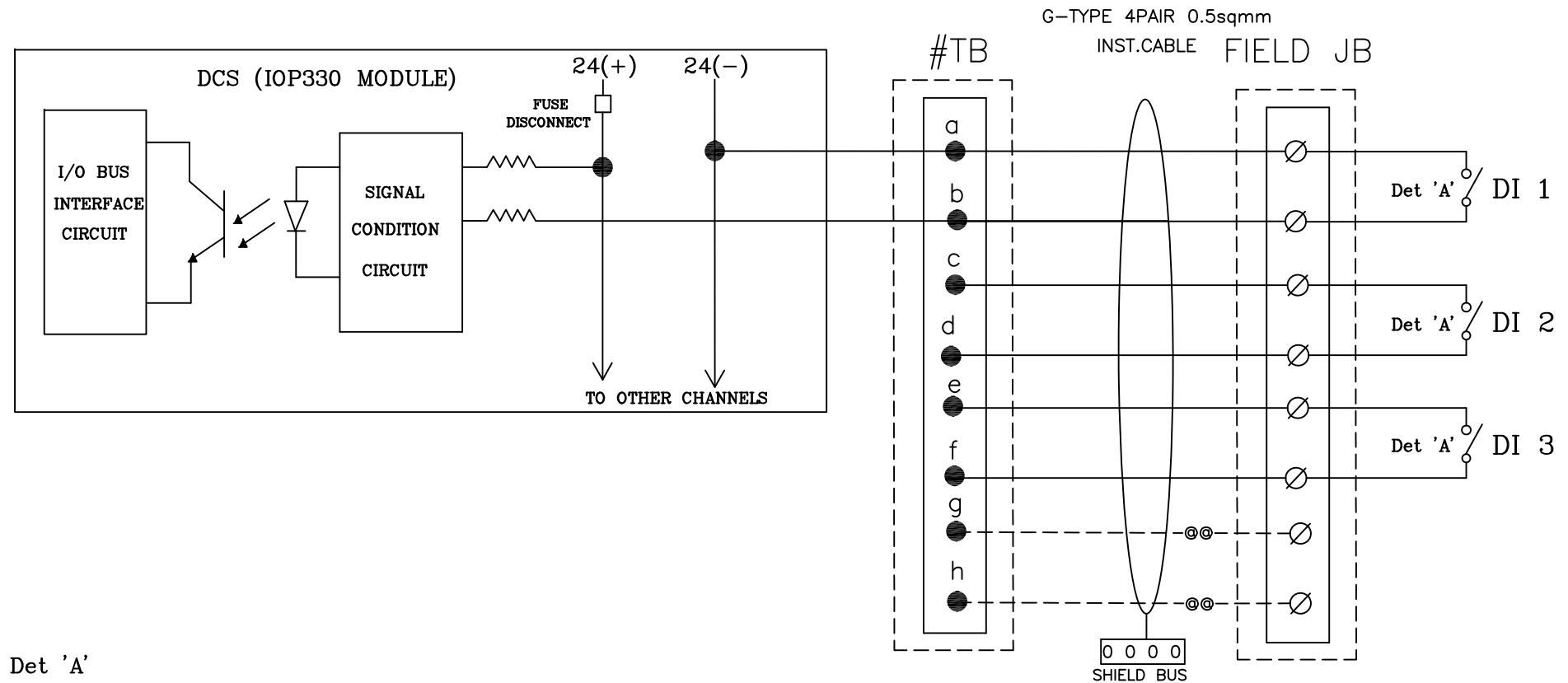
INTERFACE FOR MODULATING DRIVES – CLCS–M

DRG.NO. 9962-001-PE-405-PVI-B-152

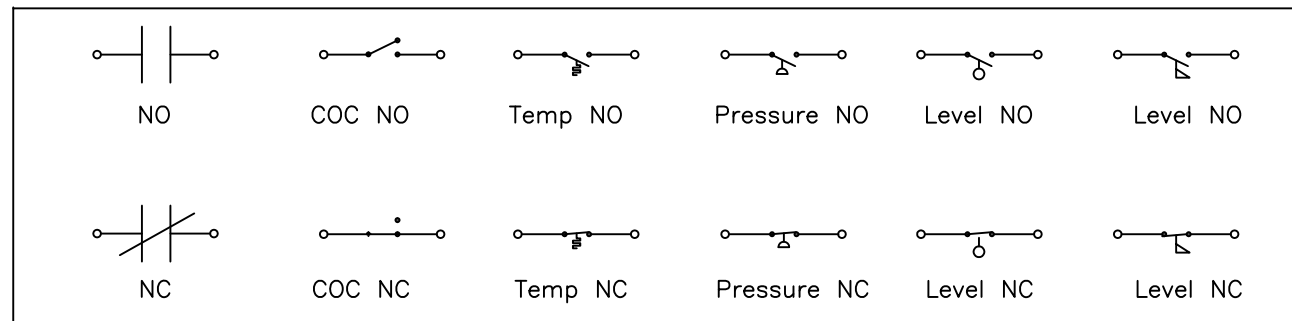
SHT 15 OF 34



# DDCMIS INTERFACE WITH DIGITAL INPUT SIGNAL



Det 'A'



NOTE:-1 #8 LEVEL TERMINAL BLOCK.

NOTE:-2 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

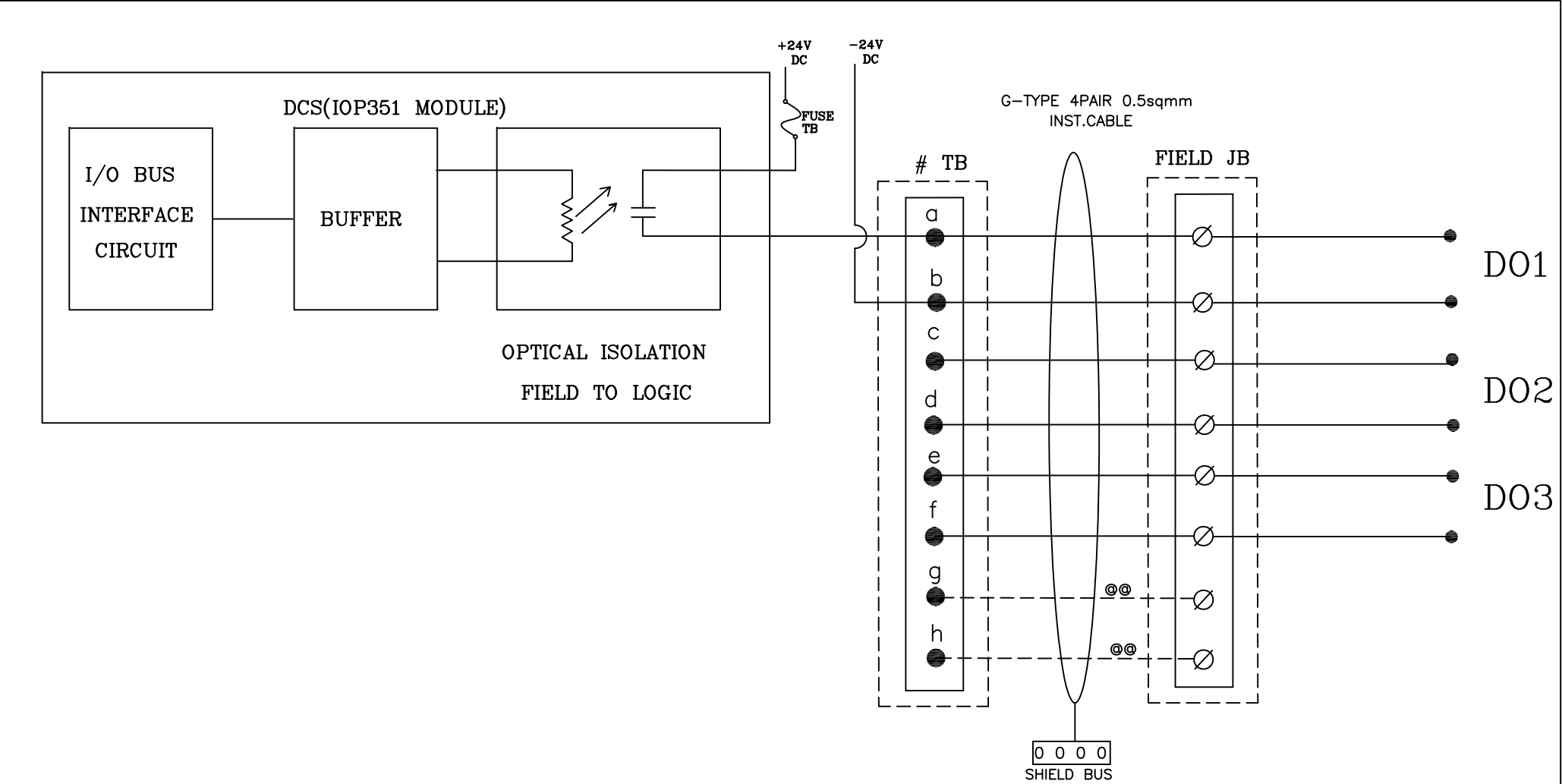


UP RAJYA VIDYUT UTPADAN NIGAM LTD  
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH DIGITAL INPUT SIGNAL

|         |                           |
|---------|---------------------------|
| DRG.NO. | 9962-001-PE-405-PVI-B-152 |
| DATE    | 11.02.2019                |
| REV.NO. | 01                        |
| SHT     | 23 OF 34                  |

DDCMIS INTERFACE WITH DIGITAL OUTPUT SIGNAL

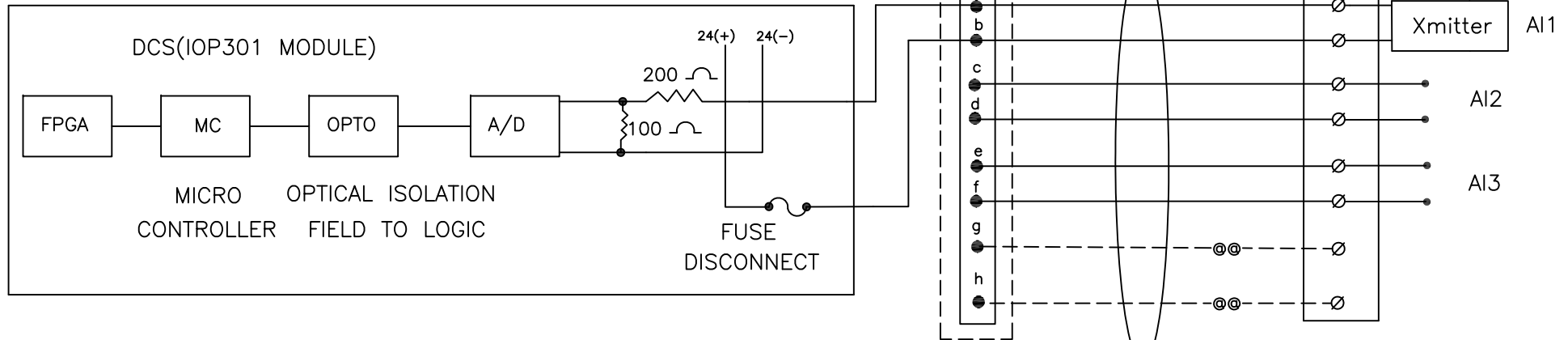


NOTE:-1 #8 LEVEL TERMINAL BLOCK.  
NOTE:-2 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

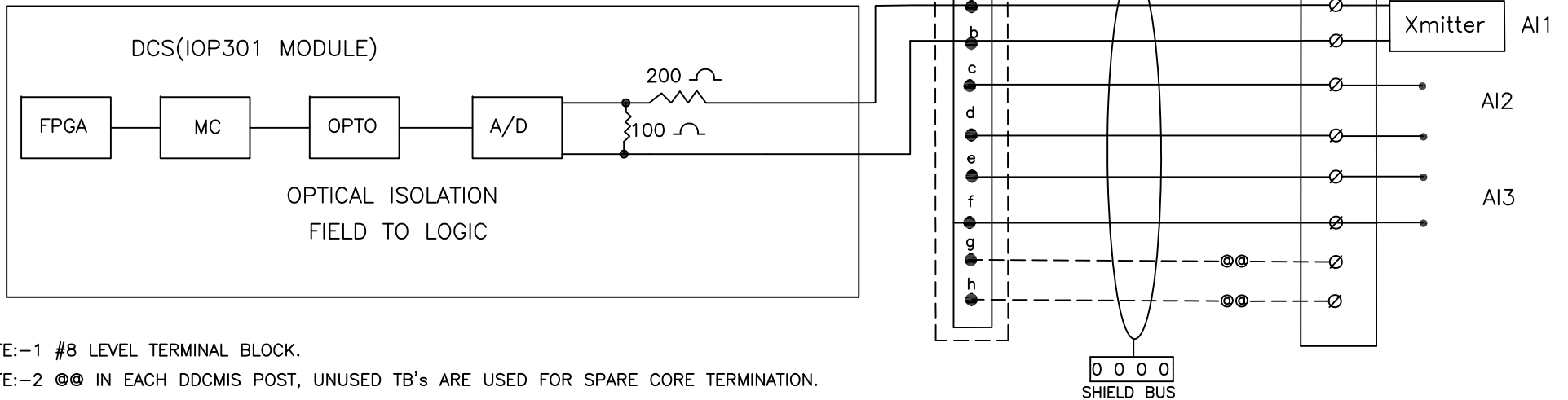
|                                                                                       |                                                           |  |         |                           |
|---------------------------------------------------------------------------------------|-----------------------------------------------------------|--|---------|---------------------------|
|  | UP RAJYA VIDYUT UTPADAN NIGAM LTD<br>1 X 660 MW PANKI TPS |  | DRG.NO. | 9962-001-PE-405-PVI-B-152 |
|                                                                                       | DDCMIS INTERFACE WITH DIGITAL OUTPUT SIGNAL               |  | DATE    | 11.02.2019                |
|                                                                                       |                                                           |  | REV.NO. | 01                        |
|                                                                                       |                                                           |  | SHT     | 24 OF 34                  |

# DDCMIS INTERFACE WITH ANALOG INPUT SIGNAL

## AI INTERFACE(4-20mA POWERED BY SYSTEM)



## AI INTERFACE(4-20mA POWERED EXTERNALLY)



NOTE:-1 #8 LEVEL TERMINAL BLOCK.

NOTE:-2 @ @ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

NOTE:-3 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.



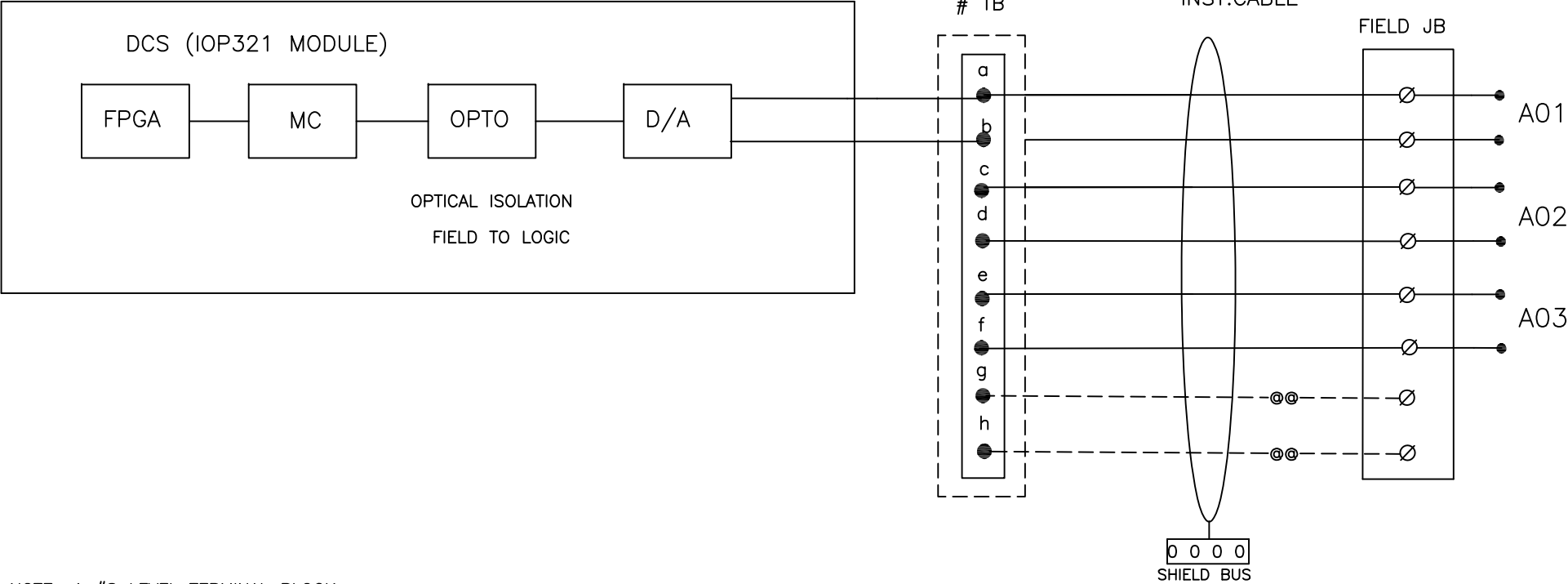
UP RAJYA VIDYUT UTPADAN NIGAM LTD  
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH ANALOG INPUT SIGNAL

|         |                           |
|---------|---------------------------|
| DRG.NO. | 9962-001-PE-405-PVI-B-152 |
| DATE    | 11.02.2019                |
| REV.NO. | 01                        |
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DDCMIS INTERFACE WITH ANALOG OUTPUT SIGNAL

AO INTERFACE



- NOTE:-1 #8 LEVEL TERMINAL BLOCK.
- NOTE:-2 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.
- NOTE:-3 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

|                                                                                       |                                            |  |         |                           |
|---------------------------------------------------------------------------------------|--------------------------------------------|--|---------|---------------------------|
|  | UP RAJYA VIDYUT UTPADAN NIGAM LTD          |  | DRG.NO. | 9962-001-PE-405-PVI-B-152 |
|                                                                                       | 1 X 660 MW PANKI TPS                       |  | DATE    | 11.02.2019                |
|                                                                                       | DDCMIS INTERFACE WITH ANALOG OUTPUT SIGNAL |  | REV.NO. | 01                        |
|                                                                                       |                                            |  | SHT     | 26 OF 34                  |



Technical specification  
for  
1X660 MW TPS PANKI EXTN.

REV. NO.

00

DATE : 04.04.2019

# PROCESS CONNECTION & PIPING

## **Chapter 8    PROCESS CONNECTION AND PIPING**

### **8.00.00    PROCESS CONNECTION PIPING**

8.01.00    The Bidder shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this chapter, enclosed installation drawings and source connection drawings on as required basis for the connection of instruments and control equipments (provided by the bidder) to the process on as required basis for the connection of all instruments and control equipments of entire plant.

The installation and source connection of various items shall generally as per NIT installation drawings (Drawing No. 14A14-DWG-I-0010), however, the bidder shall furnish during detailed Engineering. Installation drawings, GA and fabrication drawings of LIES/LIRs, other relevant drawings, material and tech data sheets of various items service wise for owner's approval/information.

8.01.01    All material, furnished under this chapter and the installation there of shall conform to the latest editions of American National standard Code for pressure piping, power piping ANSI B 31.1, ANSI B16.11, ASME Boiler and pressure Vessel codes, IBR and other applicable ASME, ANSI and state standards.

8.01.02    All material supplied under this chapter shall be suitable for intended service, process, operating conditions and type of instructions used and shall fully conform to the requirements of this specification. The bidder is responsible for the performance of equipments furnished under this specification on system basis. The bidder may offer suggestions for improvement based on his experience, during detailed engineering, which shall be subjected to the Owner's approval.

### **8.01.01    IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS**

8.01.02    All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers, sizes and dimensions etc. The size of impulse pipe shall be ½" for steam and water applications and ¾" for air and flue gas applications. The material of impulse pipe shall be same as that of main process pipe. For various applications specification of impulse pipe materials and associated fittings and valves shall be as given in table PCP..

8.01.03    SS tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. For high pressure/temperature applications (piping class A, B, C & D of the table no PCP) the material shall be ASTM A 213 TP 316H it and for other applications material shall be ASTM A 213 TP 316L. The wall thickness of the tube shall be in accordance with the ANSI B31.1 standard. The bending radius of the tube shall be greater than 6D.

8.01.04    All fittings shall be forged steel and shall conform to ANSI B16.11. The material of forged tube fittings for shaped application (e.g. tee, elbow etc) shall be ASTM A 182 Gr 316 H for high pressure/temperature applications (as defined above) and ASTM A 182 Gr 316 L for other applications. The material for bar stock tube fitting (for straight application) shall be SS 316. Metal thickness in the fittings shall be adequate to provide actual bursting strength equal to or greater than those of the impulse pipe or SS tube, with they are to be used.



The source shut off (primary process root valve) and blow down shall be ½ inch size globe valve type for all applications except for air and flue gas service wherein no source shut off valves are to be provided. For various applications the valve body material, stem material and pressure class shall be as given in table 8.1. The end connections of valves shall be of socket welded type unless otherwise specified in the instrument installation diagrams. The disc and seat ring material of carbon Steel and alloy steel valves be ASTM-A-105 and ASTM-A-182 Gr F22, hard faced with satellite (minimum hardness-350 BHN). The surface finish of 16 RMS or grater is required in the area of stem packing. The valve design shall be such that the seats can be reconditioned and stem and disc may be replaced without removing the valve body from the line.

For Pr/D.P. gauges in fluid application two way globe valve on each impulse line to the instrument and in air/flue gas application two way gate valve on each impulse line to the instrument shall be provided near the instrument. These shall be in addition to the three ways gauge cock provided along with the Pressure/Differential pressure gauges.

The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:

|                                        |                                            |
|----------------------------------------|--------------------------------------------|
| Impulse Pipe, Tube (material & rating) | ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70    |
| Valves (Material Pr. Class, size)      | ASTM A 182/ ASTM A 105 as per ASME 16.34   |
| Fitting (Size, rating, material)       | ANSI B31.1, ANSI B31.1a, ASME B16. 11-2009 |
| Installation Scheme                    | BS 6739-2009, ANSI/ISA 77.70               |

Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. Two root valves are to be used wherever pressure is more than 40 Kg/cm<sup>2</sup> or Temp>280 deg C. The end connections of valves shall be of socket welded type.

8.01.03

The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below:

| Manifold | Application / Measurement                                               |
|----------|-------------------------------------------------------------------------|
| 2 Valve  | Pressure measurements using pressure transmitters/pressure switches.    |
| 3 Valve  | Pressure measurements using differential pressure transmitter/switches. |
| 5 Valve  | Differential Pressure, Flow and Level Measurements                      |

For Pr./D.P gauges, two-way globe/gate valve shall be provided on each impulse line to the instrument in Fluid/Air & Flue Gas applications respectively .



8.01.04 Double ferruled compression type fittings shall be used only, wherever required.

8.02.00 **AIR SUPPLY PIPING**

8.02.01 All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc.

8.02.02 Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of mill, dirty air and flue gas applications. Purging scheme shall be as per drawing no. 14A14-DWG-I-0010.

8.02.03 The Bidder shall also provide and connect pneumatic tubing to E/P convertors and then to control valves. For individual supply line and control signal line to control valve, 1/4-inch size light drawn tempered PVC coated copper/SS tubing conforming to ASTM B75 shall be used. It shall be at least 0.065 inch. The fittings to be used with copper/SS tubes shall be of cast brass/SS, screwed type. All other air supply lines shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends. Fittings for air supply line shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs. Air supply piping shall be adequately sloped to prevent accumulation of condensed water within the pipe. The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports.

8.02.04 The instrument/service air supply to each equipment/devices requiring air supply shall be provided by a well designed air distribution scheme comprising of 2" GI Pipe Header with isolation valve from the instrument air and service air terminal points. In the boiler/turbine area the 2 inch head shall be provided upto most elevation of boiler/turbine floor and from this 2 inch header, 1 inch sub header shall be branched off at each floor with isolation valve. From this 1 inch sub-header, branch line of ½ inch, with isolation valve shall be provided upto various devices. Similar system is to be followed for service air required for intermittent purging in the local instrument enclosures (LIEs) Instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply except for Ash Handling System wherein it shall be provided on instrument air header at each location. The filter regulators shall be suitable for 10 kg/cm<sup>2</sup> max. Inlet pressure. The filter size shall be 5 microns and of material sintered bronze. The air set shall have 2 inch size pressure gauge and built in filter housing blow down valve. The end connection shall be ¼ inch/1/2 inch / 3/4 inch NPT as per the requirement to be finalised during detailed engineering.

8.02.05 All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.





### 8.02.06 Purge Air Connection for Air & Flue Gas applications

The continuous purging with instrument air shall be done, for all air and flue gas measurements, at the process source connection end. Necessary arrangements required for continuous purging shall be provided inside all instruments enclosures and instrument racks for Aot and flue gas applications.

For intermittent purging with service air, necessary arrangements inside all the air and flue gas enclosures shall be provided. The SS316 four ways valve provided in the SS316 tubing shall be used for isolating the transmitter and connecting the service air quick disconnect line.

Purging arrangement is not required for instrument air and service air measurement applications. Purge air lines shall be of mild steel hot dipped galvanised inside and outside as per IS1239, heavy duty with threaded ends.

### 8.03.00 Process Connections

The type of instrument source connection shall depend upon the process parameters and the tapping size. The source connection drawings shall be finalised during the engineering stage.

Size of tapping point stub, number and size of root valves for different types of measurements are as follows:

| Sl. No.                                                             | Quantity of root valves | Size of stub and root valve | Service Condition                          |
|---------------------------------------------------------------------|-------------------------|-----------------------------|--------------------------------------------|
| <b>Pressure and Differential Pressure Measurement</b>               |                         |                             |                                            |
| (i)                                                                 | 2                       | 25NB                        | $\geq 40$ bar(g) OR $425^{\circ}\text{C}$  |
| (ii)                                                                | 1                       | 15NB                        | $< 40$ bar (g) AND $425^{\circ}\text{C}$ . |
| <b>Level Measurement</b>                                            |                         |                             |                                            |
| <b>(a) Level Gauge &amp; Switch</b>                                 |                         |                             |                                            |
| (i)                                                                 | 2                       | 25NB                        | $\geq 40$ bar(g) OR $425^{\circ}\text{C}$  |
| (ii)                                                                | 1                       | 25NB                        | $< 40$ bar(g) AND $425^{\circ}\text{C}$    |
| <b>(b) Level transmitter (displacement type)</b>                    |                         |                             |                                            |
| (i)                                                                 | 2                       | 40NB                        | $\geq 40$ bar(g) OR $425^{\circ}\text{C}$  |
| (ii)                                                                | 1                       | 40NB                        | $< 40$ bar(g) AND $425^{\circ}\text{C}$    |
| <b>(c) Stand pipe for level measuring instrument</b>                |                         |                             |                                            |
| (i)                                                                 | 2                       | 80 NB                       | $\geq 40$ bar(g) OR $425^{\circ}\text{C}$  |
| (ii)                                                                | 1                       | 80 NB                       | $< 40$ bar(g) AND $425^{\circ}\text{C}$    |
| <b>Flow Measurement</b>                                             |                         |                             |                                            |
| (i)                                                                 | 2                       | 25NB                        | $\geq 40$ bar(g) OR $425^{\circ}\text{C}$  |
| (ii)                                                                | 1                       | 25NB                        | $< 40$ bar(g) AND $425^{\circ}\text{C}$    |
| <b><u>Sampling system measurement (Steam and Water Service)</u></b> |                         |                             |                                            |
| (i)                                                                 | 2                       | 25 NB                       | $\geq 40$ bar(g) OR $425^{\circ}\text{C}$  |
| (ii)                                                                | 1                       | 25 NB                       | $< 40$ bar(g) AND $425^{\circ}\text{C}$    |

### 8.04.00 **INSTALLATION AND ROUTING**

8.04.01 All instrument piping, tubing and its accessories shall be supported in a safe



manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment.

Instrument piping & tubing shall not be routed across equipment removal areas, above or below monorails, cranes, removable gratings, cable trays.

For steam and liquid measurements, the impulse pipe should preferably slope downward from source connection to instrument and instrument shall be installed below the source point. If due to any reason instrument is installed above the source point, the impulse pipe should slope upwards continuously and a 'pigtail' should be provided at the instrument to assure water seal for temperature protection. For vacuum measurements instruments shall be installed above source point and impulse pipe should slope upwards.

Impulse piping for air and flue gas shall slope upwards and instrument shall be installed above source point. If this requirement cannot be met special venting or drain provision shall be provided with vent and drain lines along with isolation valves and other accessories including drain pipes this drain is to be connected to plant drain through open funnel also. Horizontal must have a slope of not less than 40 mm per meter and must be adequately supported to maintain a constant slope and to prevent sag in piping.

All impulse piping shall be installed to permit free movement due to thermal expansion, wherein required expansion loops shall be provided.

Special accessories such as condensing pots/reservoirs shall be provided and installed wherever required. In any case condensing pots shall be provided for all level measurements in steam and water services and all flow measurements in steam and water services above 120 Deg. C. For drum level measurement required balancing chamber shall be provided and installed.

Colour coding of all impulse pipes shall be done by the bidder in line with the colour coding being followed for the parent pipes.

#### **Instrument Air & Service Air piping /tubing system**

The air supply headers, sub headers and branch pipes shall be supported properly by clamps or supports to be provided and fabricated by the bidder. Air supply piping shall be installed with a slope of over 1/100 to prevent accumulation of condensed water within the pipe. Signal/control air tubing shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy link up and checking of proper connections. Single and multi tubes shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy checkups and for connections.

#### **PIPING /TUBING SUPPORT**

Impulse piping and sample piping shall be supported at an interval not exceeding 1.5 meters. Each pipe shall be supported individually using slotted angle mounted clamps with necessary fixtures. Tubing shall run in proper perforated trays with proper cover. Tubing shall be supported inside the trays by aluminium supports.

Hangers and other fixtures required for support of piping and trays shall be provided, either by welding or by bolting on walls, ceilings and structures. Hanger clamps and other fastening hardware shall be of corrosion resistant

metals and hot-dip galvanised.

#### 8.05.00 **SHOP AND SITE TESTS**

8.05.01 The equipment and work performed as per this chapter shall be subject to shop and site test as per requirements of Vol. II & Vol. V (Quality Assurance & Inspection) other applicable clauses of this chapter and Owner approved quality assurance plan.

8.05.02 Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.

8.05.03 Hydrostatic testing

All instrument piping/tubing shall be hydrostatically tested upon completion of erection. The test pressure shall be 1.5 times the maximum process pressure. The test shall be performed either with the testing of associated process piping or without the associated process piping (by closing the root valve). In both the cases the instrument shall be isolated by closing the shut-off valve.

##### Air testing

All air headers & branch pipes shall be air tested by pressure decay method as per ANSI B31.1. Flexible hoses and short signal tubing shall be tested at normal pressure for leakage. Long signal tubing shall be tested by charging each tube with air at 2 Kg/sq.cm through a bubbler sight glass. The boiler draft and vacuum piping shall be air tested by the same method as long signal tubing.

#### 8.06.00 **LOCAL INSTRUMENT ENCLOSURE AND RACKS**

All transmitters, switches etc. in Boiler Turbine Generator measurements (except for all fuel oil applications) shall be suitably grouped together and mounted inside (i) Local instruments enclosures in case of open areas of the plant like boiler area, etc. and (ii) In local instrument racks in case of covered areas like Turbine/Generator area.

These local instrument enclosures and racks shall be furnished as per the actual requirements finalised during detailed engineering stage. The exact grouping of instruments in a particular instrument enclosure/instrument rack shall be as finalised during detailed Engineering stage subject to owner's approval. The GA of LIR should be similar to LIE except for front/rear doors and side panels. Vol. V, Part B, Chapter no. 6 shall also be referred for designing of LIE & LIR.

Sufficient spacing among adjacent transmitters shall be maintained to offer easy accessibility and operational convenience. The enclosure shall be designed with sizes to suit the grouping and to completely include all the hardware for hooking up the transmitters to the process on the basis of approved installation diagrams. A maximum of five (5) transmitters are envisaged to be grouped in one enclosure.

The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed



to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement.

Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of LIE shall be IP-55.

The enclosure shall be constructed of 1.6 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Cable glands, Channel and frame shall be 3 mm thick. Double inter locking doors shall be provided. The doors shall be the three point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key.

Neoprene/Polyurethane Gaskets shall be used between all mating sections to achieve protection class of IP-55.

The instrument racks shall be free standing type constructed of suitable 3 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack.

Bulk heads, especially designed to provide isolation from the process line vibration shall be provided. Exact fabrications details shall be as finalised during detailed Engineering stage. The junction box for LIE/LIR shall conform to IP -65 protection class.

Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided.

Each Transmitter enclosure housing instruments requiring purge air for continuous air purging, shall be provided with common purge air header, redundant air filters regulators of sufficient capacity , required pressure gauge, valves, fittings, SS tubing and individual purge meters for each purge line etc as required and indicated in instrument installation drawings enclosed herewith.

A 15 mm NB service air header shall be furnished in each instrument enclosure housing air and flue gas and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge and quick disconnect connections. A hose for connecting each header to the draft instrument line four way valves shall be furnished. The hose shall be self storing nylon tubing having a burst pressure of 15 Kg/sq Cm the size of the hose shall be ½ " min. The service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates.

The bidder shall prepare the piping drawings and the general arrangement layout drawings for each of the enclosures and racks. The special attention shall be given in the piping layout to avoid air traps liquid filled piping or water pockets in piping intended to be dry. Drawings shall indicate the arrangement of all equipment, piping, valves and fittings within the enclosures/racks and shall be subject to owner's approval.

All liquid Filled Blow down lines, except those measuring vacuum shall be connected to a two inch header which is extended through one end of the enclosure and turned downward for directing the blow down into a drain. The material of the blow down header shall be carbon steel as per ASTM A 106 Gr C or as indicated in NIT's hookup drawings whichever is better.

The bidder shall submit to the owner with his proposal a copy of his welding procedure specification together with proof of his compliance with the latest applicable welding ANSI code. Prior to any welding being performed the bidder shall submit the qualifications of the craftsmen who will perform the work.

Bidder shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR.

Each enclosure shall be provided with universal type 6/16 Amp. power receptacle, light fixture & LED lamps with wire guard and lighting switch etc. Lighting switches shall be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and power receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.

Power Supplies for miscellaneous devices shall be provided with 2P MCB located within the enclosures. MCB shall be mounted in Fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

- e) Turbine lube oil pumps
- f) Jacking oil pumps
- g) Emergency turbine trip push buttons in control room.
- h) Boiler turbine: Generator inter-trip which includes the inter connecting cables between:-
  - Boiler master fuel trip and turbine trip relays
  - Generator trip relays and turbine trip relays
  - Generator trip relays and 400 kV circuit breaker
  - Generator trip relays and generator field breaker
  - Generator trip relays and UAT breakers
- i) Fire alarm, annunciation and protection system.
- j) Any other system like safety critical circuit, trip protection circuit and for drives required for safe shut down operations of the plant.

### 9.03.00 INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted group Junction Boxes (JBs) at strategic locations is done and consequently cable with higher numbers of pairs are extensively used between field & Marshalling panels. The details of termination to be followed are mentioned in the given table below:-

| Application                                                            |                                                                               | Type of Termination |                                 |
|------------------------------------------------------------------------|-------------------------------------------------------------------------------|---------------------|---------------------------------|
| FROM (A)                                                               | TO (B)                                                                        | END A               | END B                           |
| Valves/Dampers<br>Drives (Integral<br>Junction Box)                    | Marshalling/<br>Marshalling- cum<br>Termination<br>Cubicle/ Local<br>group JB | Plug in connector   | Post mount cage<br>clamp type   |
| Transmitters,<br>Process Actuated<br>switches<br>mounted in<br>LIE/LIR | Integral Junction<br>Box of LIE/LIR                                           | Plug in connector   | Cage clamp (Rail<br>mount type) |
| RTD heads                                                              | Local Junction<br>Box                                                         | Plug in Connector   | Cage clamp (Rail<br>mount type) |
| Thermocouple                                                           | Local Junction                                                                | Plug in Connector   | Cage clamp (Rail                |

|                                                                                              |                                                      |                                |                                                      |
|----------------------------------------------------------------------------------------------|------------------------------------------------------|--------------------------------|------------------------------------------------------|
|                                                                                              | Box                                                  |                                | mount type)                                          |
| Other Field mounted Instruments                                                              | Local JB/ Group JB                                   | Plug in Connector              | Cage clamp (Rail mount type)                         |
| RTD heads                                                                                    | Temperature transmitter                              | Plug in Connector              | Screwed Cage Clamp Type                              |
| Thermocouple                                                                                 | Temperature Transmitter                              | Plug in Connector              | Screwed Cage Clamp Type                              |
| Local Junction box, Temperature Transmitter, Int. Junction box of LIE/LIR/Group JB.          | Group JB                                             | Cage clamp (Rail mount type)   | Cage clamp (Rail mount type)                         |
| Local Junction box, Temperature Transmitter, Int. Junction box of LIE/LIR/Group JB/ MCC/SWGR | Marshalling/ Marshalling – cum Termination Cubicles. | Cage clamp (Rail mount type)   | Cage clamp (Post mounted type)                       |
| Marshalling cubicle/Termination Cabinets                                                     | Electronic system Cabinet                            | Cage clamp (Post mounted type) | Plug-in connector/other system as per Mfr's standard |
| Marshalling/ Termination System Cabinets                                                     | UCD mounted equipments                               | Cage clamp (Post mounted type) | Plug in Connector/ Cage clamp Type (rail mounted)    |
| DDCMIS/PLC cabinets                                                                          | OWS, Printer etc.                                    | Plug in connector              | Plug in Connector                                    |

**Notes**

1. For Analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided.
2. Signal and Electrical connection shall be screwed connection with double compression type Nickel-plated brass/SS316 cable glands for Explosion proof area, Flame proof area and high vibration prone area.
3. All screwed connections shall be provided with double compression type Nickel-plated brass/SS316 cable glands.

**9.04.00 TERMINAL BLOCKS**

1 x 660 MW - Panki Thermal Power Station

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





For all inputs to the system emanating from the field or other systems, the bidder shall furnish terminals suitable for correct size of field cables.

- 9.04.01** All outputs going to MCC/SWGR terminal blocks, shall be rated 600 volts minimum and shall have strap screw less terminals suitable for connection of wires with ring tongue type lugs. Standard terminal blocks shall be rail mounted screw less spring loaded cage clamps type.

The terminal blocks for DDCMIS/DCS/PLC input/output connections from/to SWGR/MCC, Actuators with Integral Starter (for Coupling relays and check back signals of 11 kV and 3.3 kV auxiliaries, LT drives/valves & dampers/solenoids, CT&VT, etc.) shall be provided with built in test and disconnect facilities complete with plug, slide clamp, test socket etc. The exact type of terminal blocks to be provided by the bidder and the technical details of the same including width etc. shall be subject to owner's approval.

Terminal blocks shall be approximately sized for larger wire size of higher voltage insulated incoming conductors as necessary. All the TBs used shall be high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg C and 6.6 polyimide to withstand corrosion and the metallic portion shall be coated against rust /corrosion. All metal parts should be non –ferrous in nature.

- 9.04.02** All the Terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, test plug bolts and test plug (as specified above for SWGR connections) transparent covers, support brackets, distance sleeves, warning label, marking etc.

**The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams.**

- 9.04.03** Fuses shall not be mounted on terminal blocks. Neither step type terminal blocks nor angle mounting of terminal blocks will be acceptable. The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.

- 9.04.04** At least 20 per cent spare unused wired terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable with each panel, enclosure, cubicle, Junction Boxes, SOV Boxes, instrument racks/enclosures, termination/marshalling cabinets, etc.

All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.

For terminating each process actuated switches, drive actuators, control valves, thermocouples, RTD, etc. in local junction boxes etc. refer NIT's interfacing & wiring drawings.

- 9.04.05** For ensuring proper connections, Bidder shall provide suitable accessories, along with insulation sleeves. The exact connecting accessory shall be finalised as per application during detail engineering stage subject to owner's approval without any cost repercussions.



**9.05.00 INTERNAL PANELS/ SYSTEM CABINETS WIRING**

9.05.01 Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.

9.05.02 All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferrules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.

9.05.03 All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.

9.05.04 All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.

9.05.05 All the special tools as may be required for solder less connections shall be provided by Bidder.

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

9.05.07 Power supply wiring, and interconnecting cables between devices shall pass the following tests.

- a) Flammability test IEEE 383/1974
- b) When tested under UITPP test method or ASTM 2893/77 light transmittance of 80%
- c) When tested under IEC 754-1 maximum acid gas generation shall be 2% by weight
- d) Oxygen index not less than 30 as per ASTM D 2863.

**9.05.08** Following wire size shall be utilized for internal wiring:

- a. Current (4-20 mA) : 0.5 sq.mm  
Low voltage signals  
(AI/AO & DI signals)
- b. DO signals, Ammeter/ : 0.5 sq.mm  
voltmeter circuit, control  
switches, indicator, recorder
- c. Internal Illumination : 2.5 sq.mm
- d. Size of Power supply cables shall be as below:-

|      | <b>Load</b>   | <b>Size</b>  |
|------|---------------|--------------|
| i.   | 1 to 16 Amp.  | - 2.5 sq. mm |
| ii.  | 17 to 20 Amp. | - 4 sq. mm   |
| iii. | 21 to 32 Amp. | - 6 sq. mm   |

- |     |               |              |
|-----|---------------|--------------|
| iv. | 33 to 40 Amp. | - 10 sq. mm. |
| v.  | 41 to 60 Amp. | - 16 sq. mm  |

#### 9.06.00 **INSTRUMENTATION CABLE INSTALLATION & ROUTING**

9.06.01 Immediately prior to the installation of each cable or cable group, the raceway route to be followed shall be inspected and ascertained to be complete in installation and free of all materials detrimental to the cable or its placement. All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Owner.

9.06.02 Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:

|                                      |   |        |
|--------------------------------------|---|--------|
| From 11 kV/6.6 kV/3.3 kV tray system | - | 914 mm |
| From 415V tray system                | - | 610 mm |
| From control cable tray system       | - | 305 mm |

9.06.03 Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Double compression cable glands shall be provided.

9.06.04 The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.

#### 9.07.00 **CABLE LAYING AND ACCESSORIES**

- 1 Cables shall be laid strictly in line with cable schedule.
- 2 Identification tags for cables.  
  
Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.
- 3 Cable tray numbering and marking.  
  
To be provided at every 10m and at each end of cable way & branch connection.
- 4 Joints for less than 250 Meters run of cable shall not be permitted.
- 5 Buried cable protection



TITLE:  
**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**  
**SPECIFIC TECHNICAL REQUIREMENTS**

SPEC. NO.: **PE-TS-426-100-N002**  
SECTION: **I**  
SUB-SECTION: **ID**  
REV. NO. **0**      DATE **07.02.2020**  
SHEET **1**      OF **1**

**SUB-SECTION – ID**  
**DATASHEET-A**

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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| TECHNICAL SPECIFICATION<br>FOR SUMP PUMPS<br>DATA SHEET - A                                                                                                                                                                                                                                         |                                                                   |       |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |                                                                                                                   |                                                                                                                                                                           | Section-ID                                                                                         |                                                                                              |
|                                                                                                                                                                                                                                                                                                     |                                                                   |       |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |                                                                                                                   |                                                                                                                                                                           | Date-07.02.2020                                                                                    |                                                                                              |
| CL. NO.                                                                                                                                                                                                                                                                                             | DESCRIPTION                                                       | UNIT  | TYPE A                                                                                                                                                                                                                                                                                                                                                                                                  | TYPE B                                                                                                    |                                                                                                                   | TYPE C                                                                                                                                                                    |                                                                                                    |                                                                                              |
|                                                                                                                                                                                                                                                                                                     |                                                                   |       | Fixed Duty Submersible Sump Pump for dewatering of CW Pit in TG Hall                                                                                                                                                                                                                                                                                                                                    | Trolley mounted Portable Horizontal Sump Pump for dewatering of various sumps of the plant - Motor Driven | Trolley mounted Portable Horizontal Sump Pump for dewatering of various sumps of the plant - Diesel Engine driven | Portable Submersible Sump Pump for dewatering of CW/ACW Pump Sump, Clarified water tank & sump, Raw Water reservoir and sump, desilting chamber and Raw Water Intake Sump | Portable Submersible Sump Pump for dewatering of Transformer Yard Pit                              | Portable Submersible Sump Pump for dewatering of various cable trenches at various locations |
| 1.0.0                                                                                                                                                                                                                                                                                               | GENERAL                                                           |       |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                                                    |                                                                                              |
| 1.1.0                                                                                                                                                                                                                                                                                               | Service /Location of Sump pumps                                   |       | CW Pit                                                                                                                                                                                                                                                                                                                                                                                                  | Various sump pits in plant                                                                                | Various sump pits in plant                                                                                        | CW/ACW Pump Sump, Clarified water tank & sump, Raw Water reservoir and sump, desilting chamber and Raw Water Intake Sump                                                  | various cable trenches at various locations                                                        |                                                                                              |
| 1.2.0                                                                                                                                                                                                                                                                                               | Equipment name                                                    |       | Sump Pump                                                                                                                                                                                                                                                                                                                                                                                               | Sump Pump                                                                                                 | Sump Pump                                                                                                         | Sump Pump                                                                                                                                                                 | Sump Pump                                                                                          |                                                                                              |
| 1.3.0                                                                                                                                                                                                                                                                                               | Pump type                                                         |       | Fixed Duty Submersible sump pumps                                                                                                                                                                                                                                                                                                                                                                       | Portable Horizontal Centrifugal Sump Pumps                                                                | Portable Horizontal Centrifugal Sump Pumps                                                                        | Portable Submersible sump pumps                                                                                                                                           | Portable Submersible sump pumps                                                                    |                                                                                              |
| 1.4.0                                                                                                                                                                                                                                                                                               | Duty                                                              |       | Intermittent                                                                                                                                                                                                                                                                                                                                                                                            | Intermittent                                                                                              | Intermittent                                                                                                      | Intermittent                                                                                                                                                              | Intermittent                                                                                       |                                                                                              |
| 1.5.0                                                                                                                                                                                                                                                                                               | Location                                                          |       | Indoor/ Outdoor                                                                                                                                                                                                                                                                                                                                                                                         | Indoor/ Outdoor                                                                                           | Indoor/ Outdoor                                                                                                   | Indoor/ Outdoor                                                                                                                                                           | Indoor/ Outdoor                                                                                    |                                                                                              |
| 1.6.0                                                                                                                                                                                                                                                                                               | Maximum Ambient Temperature                                       | °C    | 50                                                                                                                                                                                                                                                                                                                                                                                                      | 50                                                                                                        | 50                                                                                                                | 50                                                                                                                                                                        | 50                                                                                                 |                                                                                              |
| 1.7.0                                                                                                                                                                                                                                                                                               | Drive                                                             |       | Motor Driven                                                                                                                                                                                                                                                                                                                                                                                            | Motor Driven                                                                                              | Diesel Engine driven                                                                                              | Motor Driven                                                                                                                                                              | Motor Driven                                                                                       |                                                                                              |
| 1.8.0                                                                                                                                                                                                                                                                                               | Motor Rating (For Motor Driven Pumps)                             |       | Drive Motor shall be rated, at an ambient temp. of 50 Deg C, with a margin of at least 15 % over the maximum power required at any condition of the entire charecteristic curve of the pump, including voltage and frequency variation .<br>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. |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                                                    |                                                                                              |
| 2.0.0                                                                                                                                                                                                                                                                                               | PUMP PARAMETERS                                                   |       |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                                                    |                                                                                              |
| 2.1.0                                                                                                                                                                                                                                                                                               | Design capacity / Rated Flow                                      | M3/hr | 40                                                                                                                                                                                                                                                                                                                                                                                                      | 20                                                                                                        | 20                                                                                                                | 100                                                                                                                                                                       | 40                                                                                                 |                                                                                              |
| 2.2.0                                                                                                                                                                                                                                                                                               | Total head at rated capacity                                      | MWC   | 22 (Suitable for working in Range 5.5 to 27.5)                                                                                                                                                                                                                                                                                                                                                          | 15 (Suitable for working in Range 4 to 19)                                                                | 15 (Suitable for working in Range 4 to 19)                                                                        | 20 (Suitable for working in Range 5 to 25)                                                                                                                                | 12 (Suitable for working in Range 3 to 15)                                                         |                                                                                              |
| 2.3.0                                                                                                                                                                                                                                                                                               | Total no.of pumps installed/required                              | Nos.  | 2                                                                                                                                                                                                                                                                                                                                                                                                       | 2                                                                                                         | 2                                                                                                                 | 4                                                                                                                                                                         | 3                                                                                                  |                                                                                              |
| 2.4.0                                                                                                                                                                                                                                                                                               | No. of pumps working / Standby                                    | Nos.  | 1 Working + 1 Standby for each pit                                                                                                                                                                                                                                                                                                                                                                      | -                                                                                                         | -                                                                                                                 | -                                                                                                                                                                         | -                                                                                                  |                                                                                              |
| 2.5.0                                                                                                                                                                                                                                                                                               | Parallel operation required                                       |       | YES                                                                                                                                                                                                                                                                                                                                                                                                     | -                                                                                                         | -                                                                                                                 | -                                                                                                                                                                         | -                                                                                                  |                                                                                              |
| 2.6.0                                                                                                                                                                                                                                                                                               | Pump RPM                                                          |       | 1500 (Max.)                                                                                                                                                                                                                                                                                                                                                                                             | 1500 (Max.)                                                                                               | 1500 (Max.)                                                                                                       | 1500 (Max.)                                                                                                                                                               | 1500 (Max.)                                                                                        |                                                                                              |
| 2.7.0                                                                                                                                                                                                                                                                                               | Range of operation                                                | %     | 30 to 150 % of the rated flow                                                                                                                                                                                                                                                                                                                                                                           | 30 to 150 % of the rated flow                                                                             | 30 to 150 % of the rated flow                                                                                     | 30 to 150 % of the rated flow                                                                                                                                             | 30 to 150 % of the rated flow                                                                      |                                                                                              |
| 2.8.0                                                                                                                                                                                                                                                                                               | Pump design standard                                              |       | IS 5120/IS 14220/IS 8034/IS 5600                                                                                                                                                                                                                                                                                                                                                                        | IS 5120/IS 14220/IS 8034/IS 5600                                                                          | IS 5120/IS 14220/IS 8034/IS 5600                                                                                  | IS 5120/IS 14220/IS 8034/IS 5600                                                                                                                                          | IS 5120/IS 14220/IS 8034/IS 5600                                                                   |                                                                                              |
| 2.9.0                                                                                                                                                                                                                                                                                               | Max. particle size to be handled                                  | MM    | 20                                                                                                                                                                                                                                                                                                                                                                                                      | 20                                                                                                        | 20                                                                                                                | 20                                                                                                                                                                        | 20                                                                                                 |                                                                                              |
| 2.10.0                                                                                                                                                                                                                                                                                              | Minimum Suction Lift                                              | M     | -                                                                                                                                                                                                                                                                                                                                                                                                       | 6                                                                                                         | 6                                                                                                                 | -                                                                                                                                                                         | -                                                                                                  |                                                                                              |
| 3.0.0                                                                                                                                                                                                                                                                                               | LIQUID DATA                                                       |       |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                                                    |                                                                                              |
| 3.1.0                                                                                                                                                                                                                                                                                               | Liquid handled                                                    |       | Water with solid particles, cotton wastes, silica, mud/sludges, coal particles, ash particles etc.                                                                                                                                                                                                                                                                                                      | Water with solid particles, cotton wastes, silica, mud/sludges, coal particles, ash particles etc.        | Water with solid particles, cotton wastes, silica, mud/sludges, coal particles, ash particles etc.                | Water with solid particles, cotton wastes, silica, mud/sludges, coal particles, ash particles etc.                                                                        | Water with solid particles, cotton wastes, silica, mud/sludges, coal particles, ash particles etc. |                                                                                              |
| 3.2.0                                                                                                                                                                                                                                                                                               | Specific gravity                                                  |       | 1.1                                                                                                                                                                                                                                                                                                                                                                                                     | 1.1                                                                                                       | 1.1                                                                                                               | 1.1                                                                                                                                                                       | 1.1                                                                                                |                                                                                              |
| 3.3.0                                                                                                                                                                                                                                                                                               | Temperature (max.)                                                | °C    | 50                                                                                                                                                                                                                                                                                                                                                                                                      | 50                                                                                                        | 50                                                                                                                | 50                                                                                                                                                                        | 50                                                                                                 |                                                                                              |
| 4.0.0                                                                                                                                                                                                                                                                                               | DESIGN AND CONSTRUCTION                                           |       |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                                                    |                                                                                              |
|                                                                                                                                                                                                                                                                                                     | FEATURES                                                          |       |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                                                    |                                                                                              |
| 4.1.0                                                                                                                                                                                                                                                                                               | Impeller type                                                     |       | Open/Semi-open, Non-clog type                                                                                                                                                                                                                                                                                                                                                                           | Open/Semi-open, Non-clog type                                                                             | Open/Semi-open, Non-clog type                                                                                     | Open/Semi-open, Non-clog type                                                                                                                                             | Open/Semi-open, Non-clog type                                                                      |                                                                                              |
| 4.2.0                                                                                                                                                                                                                                                                                               | Flange drilling standard                                          |       | ANSI B 16.5                                                                                                                                                                                                                                                                                                                                                                                             | ANSI B 16.5                                                                                               | ANSI B 16.5                                                                                                       | ANSI B 16.5                                                                                                                                                               | ANSI B 16.5                                                                                        |                                                                                              |
| 4.3.0                                                                                                                                                                                                                                                                                               | Motor Support Elevation                                           | M     | -                                                                                                                                                                                                                                                                                                                                                                                                       | -                                                                                                         | -                                                                                                                 | -                                                                                                                                                                         | -                                                                                                  |                                                                                              |
| 4.4.0                                                                                                                                                                                                                                                                                               | Sump Invert Level                                                 | M     | -                                                                                                                                                                                                                                                                                                                                                                                                       | -                                                                                                         | -                                                                                                                 | -                                                                                                                                                                         | -                                                                                                  |                                                                                              |
| 4.5.0                                                                                                                                                                                                                                                                                               | Dimension of Sump Pit required in the pit to be dewatered (LXBXH) | MxMxM | -                                                                                                                                                                                                                                                                                                                                                                                                       | -                                                                                                         | -                                                                                                                 | -                                                                                                                                                                         | -                                                                                                  |                                                                                              |
| 5.0.0                                                                                                                                                                                                                                                                                               | MATERIAL OF CONSTRUCTION                                          |       |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                                                    |                                                                                              |
| 5.1.0                                                                                                                                                                                                                                                                                               | Casing / Suction bell                                             |       | 2% NiCl to IS 210 Gr. FG 260                                                                                                                                                                                                                                                                                                                                                                            | 2% NiCl to IS 210 Gr. FG 260                                                                              | 2% NiCl to IS 210 Gr. FG 260                                                                                      | 2% NiCl to IS 210 Gr. FG 260                                                                                                                                              | 2% NiCl to IS 210 Gr. FG 260                                                                       |                                                                                              |
| 5.2.0                                                                                                                                                                                                                                                                                               | Impeller                                                          |       | ASTM A 351 CF8M                                                                                                                                                                                                                                                                                                                                                                                         | ASTM A 351 CF8M                                                                                           | ASTM A 351 CF8M                                                                                                   | ASTM A 351 CF8M                                                                                                                                                           | ASTM A 351 CF8M                                                                                    |                                                                                              |
| 5.3.0                                                                                                                                                                                                                                                                                               | Impeller shaft                                                    |       | SS-410                                                                                                                                                                                                                                                                                                                                                                                                  | SS-410                                                                                                    | SS-410                                                                                                            | SS-410                                                                                                                                                                    | SS-410                                                                                             |                                                                                              |
| 5.4.0                                                                                                                                                                                                                                                                                               | Wear ring (where applicable)                                      |       | Austenitic cast iron                                                                                                                                                                                                                                                                                                                                                                                    | Austenitic cast iron                                                                                      | Austenitic cast iron                                                                                              | Austenitic cast iron                                                                                                                                                      | Austenitic cast iron                                                                               |                                                                                              |
| 5.5.0                                                                                                                                                                                                                                                                                               | Shaft sleeve (where applicable)                                   |       | SS-410                                                                                                                                                                                                                                                                                                                                                                                                  | SS-410                                                                                                    | SS-410                                                                                                            | SS-410                                                                                                                                                                    | SS-410                                                                                             |                                                                                              |
| 5.6.0                                                                                                                                                                                                                                                                                               | Column Pipe (where applicable)                                    |       | Not Applicable                                                                                                                                                                                                                                                                                                                                                                                          | Not Applicable                                                                                            | Not Applicable                                                                                                    | Not Applicable                                                                                                                                                            | Not Applicable                                                                                     |                                                                                              |
| 5.7.0                                                                                                                                                                                                                                                                                               | Pump and motor coupling                                           |       | -                                                                                                                                                                                                                                                                                                                                                                                                       | -                                                                                                         | -                                                                                                                 | -                                                                                                                                                                         | -                                                                                                  |                                                                                              |
| 5.8.0                                                                                                                                                                                                                                                                                               | Fasteners                                                         |       | SS-316                                                                                                                                                                                                                                                                                                                                                                                                  | SS-316                                                                                                    | SS-316                                                                                                            | SS-316                                                                                                                                                                    | SS-316                                                                                             |                                                                                              |
| 5.9.0                                                                                                                                                                                                                                                                                               | Gland (Where applicable)                                          |       | C.I, IS-210, FG-260/ Equivalent                                                                                                                                                                                                                                                                                                                                                                         | C.I, IS-210, FG-260/ Equivalent                                                                           | C.I, IS-210, FG-260/ Equivalent                                                                                   | C.I, IS-210, FG-260/ Equivalent                                                                                                                                           | C.I, IS-210, FG-260/ Equivalent                                                                    |                                                                                              |
|                                                                                                                                                                                                                                                                                                     | Gland Packing (Where applicable)                                  |       | Braided Impregnated Teflon (Asbestos Free)                                                                                                                                                                                                                                                                                                                                                              | Braided Impregnated Teflon (Asbestos Free)                                                                | Braided Impregnated Teflon (Asbestos Free)                                                                        | Braided Impregnated Teflon (Asbestos Free)                                                                                                                                | Braided Impregnated Teflon (Asbestos Free)                                                         |                                                                                              |
| 5.10.0                                                                                                                                                                                                                                                                                              | Mechanical seal                                                   |       | As applicable                                                                                                                                                                                                                                                                                                                                                                                           | As applicable                                                                                             | As applicable                                                                                                     | As applicable                                                                                                                                                             | As applicable                                                                                      |                                                                                              |
| 5.11.0                                                                                                                                                                                                                                                                                              | Pump Lubrication                                                  |       | SELF/Oil/Grease                                                                                                                                                                                                                                                                                                                                                                                         | SELF/Oil/Grease                                                                                           | SELF/Oil/Grease                                                                                                   | SELF/Oil/Grease                                                                                                                                                           | SELF/Oil/Grease                                                                                    |                                                                                              |
| 5.12.0                                                                                                                                                                                                                                                                                              | Pump line shaft lubrication                                       |       | N/A                                                                                                                                                                                                                                                                                                                                                                                                     | N/A                                                                                                       | N/A                                                                                                               | N/A                                                                                                                                                                       | N/A                                                                                                |                                                                                              |
| 5.13.0                                                                                                                                                                                                                                                                                              | Strainer (Body / Mesh)                                            |       | Body (2.5% NiCl to IS 210 Gr. FG 260)/ Mesh (SS 316)                                                                                                                                                                                                                                                                                                                                                    | Body (2.5% NiCl to IS 210 Gr. FG 260)/ Mesh (SS 316)                                                      | Body (2.5% NiCl to IS 210 Gr. FG 260)/ Mesh (SS 316)                                                              | Body (2.5% NiCl to IS 210 Gr. FG 260)/ Mesh (SS 316)                                                                                                                      | Body (2.5% NiCl to IS 210 Gr. FG 260)/ Mesh (SS 316)                                               |                                                                                              |
| 5.14.0                                                                                                                                                                                                                                                                                              | Line Shaft Bearing (Where Applicable)                             |       | Not Applicable                                                                                                                                                                                                                                                                                                                                                                                          | Not Applicable                                                                                            | Not Applicable                                                                                                    | Not Applicable                                                                                                                                                            | Not Applicable                                                                                     |                                                                                              |
| 5.15.0                                                                                                                                                                                                                                                                                              | Line Shaft Coupling (Where Applicable)                            |       | Not Applicable                                                                                                                                                                                                                                                                                                                                                                                          | Not Applicable                                                                                            | Not Applicable                                                                                                    | Not Applicable                                                                                                                                                            | Not Applicable                                                                                     |                                                                                              |
| 5.16.0                                                                                                                                                                                                                                                                                              | Base Plate                                                        |       | -                                                                                                                                                                                                                                                                                                                                                                                                       | CS as per IS 2062 (Epoxy Coated)                                                                          | CS as per IS 2062 (Epoxy Coated)                                                                                  | -                                                                                                                                                                         | -                                                                                                  |                                                                                              |
| Note : Bidder's may offer alternative materials, if they are superior to that specified above for the indicated service of the pump.                                                                                                                                                                |                                                                   |       |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                                                    |                                                                                              |
| MOC of all the parts coming in direct contact with Sea Water shall be Duplex SS.                                                                                                                                                                                                                    |                                                                   |       |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                                                    |                                                                                              |
| 6.0.0                                                                                                                                                                                                                                                                                               | INSPECTION AND TESTING                                            |       | As per approved quality plan by BHEL/ Customer                                                                                                                                                                                                                                                                                                                                                          |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                                                    |                                                                                              |
| 7.0.0                                                                                                                                                                                                                                                                                               | SUPPLY OF ACCESSORIES AND SERVICE.                                |       |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                                                    |                                                                                              |
| 7.1.0                                                                                                                                                                                                                                                                                               | Counter Flanges with Nuts,Bolts, Gaskets etc.                     |       | Yes                                                                                                                                                                                                                                                                                                                                                                                                     | Yes                                                                                                       | Yes                                                                                                               | Yes                                                                                                                                                                       | Yes                                                                                                |                                                                                              |

| <div><div><div>07/11</div><div>07/11</div></div><div>PROJECT: 1X660 MW PANKI TPS</div></div>                                                                 |                                                                                                                                                                |      |                                                                      |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                       | Specification No: PE-TS-426-100-N002                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| TECHNICAL SPECIFICATION<br>FOR SUMP PUMPS                                                                                                                    |                                                                                                                                                                |      |                                                                      |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                       | Section-ID                                                                                   |
| DATA SHEET - A                                                                                                                                               |                                                                                                                                                                |      |                                                                      |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                       | Date-07.02.2020                                                                              |
| CL. NO.                                                                                                                                                      | DESCRIPTION                                                                                                                                                    | UNIT | TYPE A                                                               | TYPE B                                                                                                    |                                                                                                                   | TYPE C                                                                                                                                                                    |                                                                       |                                                                                              |
|                                                                                                                                                              |                                                                                                                                                                |      | Fixed Duty Submersible Sump Pump for dewatering of CW Pit in TG Hall | Trolley mounted Portable Horizontal Sump Pump for dewatering of various sumps of the plant - Motor Driven | Trolley mounted Portable Horizontal Sump Pump for dewatering of various sumps of the plant - Diesel Engine driven | Portable Submersible Sump Pump for dewatering of CW/ACW Pump Sump, Clarified water tank & sump, Raw Water reservoir and sump, desilting chamber and Raw Water Intake Sump | Portable Submersible Sump Pump for dewatering of Transformer Yard Pit | Portable Submersible Sump Pump for dewatering of various cable trenches at various locations |
| 7.2.0                                                                                                                                                        | Elastomer cables for connecting pump with its panel length (M)                                                                                                 |      | 30M                                                                  | 30M                                                                                                       | Not Applicable                                                                                                    | 30M                                                                                                                                                                       | 30M                                                                   | 30M                                                                                          |
| 7.3.0                                                                                                                                                        | Relay based control panel with integral starter                                                                                                                |      | Starter panel common for two(2) sump pumps with IP 65 protection     | Starter panel for each sump pump with IP 65 protection                                                    | Not Applicable                                                                                                    | Starter panel for each sump pump with IP 65 protection                                                                                                                    | Starter panel for each sump pump with IP 65 protection                | Starter panel for each sump pump with IP 65 protection                                       |
| 7.4.0                                                                                                                                                        | Suction and Discharge pressure gauge with root valve / pump                                                                                                    |      | 1 No. for each pump                                                  | Not Applicable                                                                                            | Not Applicable                                                                                                    | Not Applicable                                                                                                                                                            | Not Applicable                                                        | Not Applicable                                                                               |
| 7.5.0                                                                                                                                                        | Discharge hose                                                                                                                                                 |      |                                                                      |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                       |                                                                                              |
|                                                                                                                                                              | - Hose length per pump                                                                                                                                         |      | As per Section IA                                                    | As per Section IA                                                                                         | As per Section IA                                                                                                 | As per Section IA                                                                                                                                                         | As per Section IA                                                     | As per Section IA                                                                            |
|                                                                                                                                                              | - Hose dia                                                                                                                                                     |      | Min. 80 NB or to suit pump discharge                                 | Min. 65 NB or to suit pump discharge                                                                      | Min. 65 NB or to suit pump discharge                                                                              | Min. 100 NB or to suit pump discharge                                                                                                                                     | Min. 80 NB or to suit pump discharge                                  | Min. 50 NB or to suit pump discharge                                                         |
|                                                                                                                                                              | - No. of Hose pipe per pump                                                                                                                                    |      | As per Section IA                                                    | As per Section IA                                                                                         | As per Section IA                                                                                                 | As per Section IA                                                                                                                                                         | As per Section IA                                                     | As per Section IA                                                                            |
| 7.6.0                                                                                                                                                        | Orifice Plate and its arrangement at Pump Discharge (Refer Note A)                                                                                             |      | 1 no. (suitable for 5 MWC pressure drop)                             | 1 no. (suitable for 3 MWC pressure drop)                                                                  | 1 no. (suitable for 3 MWC pressure drop)                                                                          | 1 no. (suitable for 5 MWC pressure drop)                                                                                                                                  | 1 no. (suitable for 2 MWC pressure drop)                              | 1 no. (suitable for 2 MWC pressure drop)                                                     |
| 7.7.0                                                                                                                                                        | Cables (*) for connecting the starter panel with the power supply source - Length (M) / pump (*)including plug matching with purchaser's 63 Amp welding socket |      | NA                                                                   | 50 m                                                                                                      | Not Applicable                                                                                                    | 25 m                                                                                                                                                                      | 25 m                                                                  | 25 m                                                                                         |
| 7.8.0                                                                                                                                                        | Chains (for pump lifting purpose)                                                                                                                              |      | Yes(15M)                                                             | -                                                                                                         | -                                                                                                                 | Yes(15M)                                                                                                                                                                  | Yes(15M)                                                              | Yes(15M)                                                                                     |
| 7.9.0                                                                                                                                                        | Suction Strainers                                                                                                                                              |      | Yes                                                                  | Yes                                                                                                       | Yes                                                                                                               | Yes                                                                                                                                                                       | Yes                                                                   | Yes                                                                                          |
| 7.10.0                                                                                                                                                       | Pump Stool                                                                                                                                                     |      | Yes                                                                  | Yes, If required                                                                                          | Yes, If required                                                                                                  | Yes                                                                                                                                                                       | Yes                                                                   | Yes                                                                                          |
| 7.11.0                                                                                                                                                       | Wheel trolley required per pump                                                                                                                                |      | No                                                                   | Yes                                                                                                       | Yes                                                                                                               | Yes                                                                                                                                                                       | Yes                                                                   | Yes                                                                                          |
| 7.12.0                                                                                                                                                       | Level switches for                                                                                                                                             |      | Top mounted displacer type                                           | Not Applicable                                                                                            | Not Applicable                                                                                                    | Float type level probe integral with pump                                                                                                                                 | Float type level probe integral with pump                             | Float type level probe integral with pump                                                    |
|                                                                                                                                                              | - Very High level                                                                                                                                              |      | YES                                                                  | -                                                                                                         | -                                                                                                                 | -                                                                                                                                                                         | -                                                                     | -                                                                                            |
|                                                                                                                                                              | - High level                                                                                                                                                   |      | YES                                                                  | -                                                                                                         | -                                                                                                                 | -                                                                                                                                                                         | -                                                                     | -                                                                                            |
|                                                                                                                                                              | - Very Low level                                                                                                                                               |      | YES                                                                  | -                                                                                                         | -                                                                                                                 | YES                                                                                                                                                                       | YES                                                                   | YES                                                                                          |
| 7.13.0                                                                                                                                                       | Flow regulating globe valve fitted at hose                                                                                                                     |      | Not Applicable                                                       | Not Applicable                                                                                            | Not Applicable                                                                                                    | Not Applicable                                                                                                                                                            | Not Applicable                                                        | Not Applicable                                                                               |
| 8.0.0                                                                                                                                                        | Special Requirements                                                                                                                                           |      |                                                                      |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                       |                                                                                              |
|                                                                                                                                                              | Male/female hose coupling with accessories for connecting two hose pipes                                                                                       |      | YES                                                                  | YES                                                                                                       | YES                                                                                                               | YES                                                                                                                                                                       | YES                                                                   | YES                                                                                          |
| Note A: Orifice plate shall be installed in the discharge hose pipe. Suitable flanges/counterflanges with nut, bolts and gasket is to be provided by bidder. |                                                                                                                                                                |      |                                                                      |                                                                                                           |                                                                                                                   |                                                                                                                                                                           |                                                                       |                                                                                              |
| 9.0.0                                                                                                                                                        | MANDATORY SPARES (Optional):                                                                                                                                   | NA   | NA                                                                   | Applicable (Refer annexure-I to Datasheet-A)                                                              | NA                                                                                                                | NA                                                                                                                                                                        | NA                                                                    | NA                                                                                           |

**1 x 660 MW PANKI TPS****REQUIREMENT OF MANDATORY SPARES**

| SL. NO.  | DESCRIPTION                                               | MF | TOTAL QUANTITY INCLUDED FOR THE PROJECT                                    | REMARKS |
|----------|-----------------------------------------------------------|----|----------------------------------------------------------------------------|---------|
| 14.02.00 | <b>415 V Motors</b>                                       | 1  |                                                                            |         |
| 14.02.01 | Terminal plates                                           | 1  | 10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW |         |
| 14.02.02 | Heaters                                                   | 2  | 2 sets                                                                     |         |
| 14.02.03 | Greasing arrangements                                     | 4  | 4 sets each type of motor                                                  |         |
| 14.02.04 | Motor of each type and rating                             | 1  | 10% of the installed quantity or minimum 1 number whichever be higher      |         |
| 14.02.05 | Bearings (DE and NDE) for each type and rating of motors. | 4  | 4 sets                                                                     |         |
| 14.02.06 | Stator winding coils for all type of LT motors            | 1  | One (1) set                                                                |         |
| 14.02.07 | Dust seals and gaskets for each type of motors            | 3  | Three (3) sets                                                             |         |



TITLE:  
**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**  
  
**STANDARD TECHNICAL REQUIREMENTS**

SPEC. NO.: **PE-TS-426-100-N002**  
SECTION: **II**  
SUB-SECTION: **IIA**  
REV. NO. **0**      DATE **07.02.2020**  
SHEET **1**      OF **1**

**SUB-SECTION - IIA**

**STANDARD TECHNICAL SPECIFICATION (MECHANICAL)**

|                                                                                  |                                |                                       |                 |
|----------------------------------------------------------------------------------|--------------------------------|---------------------------------------|-----------------|
|  | TITLE :                        | SPECIFICATION NO.: PE-TS-999-172-N001 |                 |
|                                                                                  | TECHNICAL SPECIFICATION FOR    | SECTION: IIA                          |                 |
|                                                                                  | SUMP PUMPS                     | REV. NO. 0                            | DATE : 14.06.16 |
|                                                                                  | STANDARD TECHNICAL REQUIREMENT | SHEET                                 | OF              |

## 1.00.00 GENERAL

1.01.00 This specification covers the design, performance requirement, constructional features, material requirements, manufacture, inspection and testing at the manufacturer's and/or his sub-contractor's works and painting requirements for delivery of Sump Pump/submersible pumps complete with all accessories as specified hereinafter.

1.02.00 The design, performance, major constructional features, materials of construction etc., of the Sump Pumps/submersible pumps shall be guided by Data Sheet-A. The requirements of this specification shall also be taken care of.

## 2.00.00 Codes and Standards

2.01.00 The design, performance requirement, material requirements, manufacture, inspection and testing of the Sump Pumps shall generally comply with the requirements of all applicable Indian/British/American/DIN standards, in particular the following :

IS 8034 : Technical requirements for submersible pump sets

IS 5600 : Technical requirements for rotodynamic pumps for handling sewage and drainage.

IS 1710 : Vertical turbine pumps for clear, cold and fresh water.

IS 5120 : Technical requirements - Rotodynamic special purpose pumps

IS 5600 : Sewage and drainage pumps

IS 5639 : Pumps for handling chemical and corrosive mixed flow and axial flow pumps

IS 9137 : Code for acceptance for centrifugal, mixed flow and axial flow pumps

BS 5316 : Acceptance tests for centrifugal, mixed flow and axial flow pumps

Hydraulic  
Institute  
Standards of  
USA  
API 610

: Centrifugal pumps general refinery services

2.02.00 In case of any contradiction between the above standards and this specification, the



|                                                                                   |                                |                                       |
|-----------------------------------------------------------------------------------|--------------------------------|---------------------------------------|
|  | TITLE :                        | SPECIFICATION NO.: PE-TS-999-172-N001 |
|                                                                                   | TECHNICAL SPECIFICATION FOR    | SECTION: IIA                          |
|                                                                                   | SUMP PUMPS                     | REV. NO. 0      DATE : 14.06.16       |
|                                                                                   | STANDARD TECHNICAL REQUIREMENT | SHEET                      OF         |

stipulations in this specification shall prevail and shall be binding on the bidder.

### **3.00.00      General Description**

3.01.00      Sump pumps/submersible pumps specified hereinafter shall be used to dewater various sump pits in the power house and other plant area where gravity draining is not envisaged to ensure general housekeeping.

Type of Sump Pumps required under this specification are described in Section-ID/Data Sheet-A, the following requirements shall be taken care, as applicable.

#### **3.01.01      Fixed Type Sump Pumps**

Fixed type Sump pumps shall be electric motor driven permanently installed and shall be vertical wet pit bottom suction volute type and will handle drainage water, containing solid particles with sludges, polluted liquid etc. from the area where they are installed. These pumps will run continuously by the use of high and low level switches in the sump. Particle size expected in the water may be of the order of 30mm.

#### **3.01.02      Fixed Duty Type Submersible Pumps**

Fixed duty type submersible pumps shall be electric motor driven permanently installed and the motor shall be integral part of the pumps and the pump & motor shall be single unit i.e. monoblock type which be submerged in the water. Submersible pump will handle drainage water, containing solid particles with sludges, polluted liquid etc. from the area where they are installed. These pumps will run continuously by the use of high and low level switches in the sump. Particle size expected in the water may be of the order of 30mm.

#### **3.01.03      Trolley Mounted portable sump pumps**

These pumps shall be horizontal centrifugal, either electric motor driven or Diesel engine driven as specified in Data Sheet-A and shall be portable type. Each pump set alongwith drive, control panel etc., shall be mounted on a trolley for ease of transportation. These pumps shall be suitable for handling drainage water containing hard solid particles, sludge, polluted liquid with expected particle size of 30mm.

#### **3.01.04      Trolley Mounted Vertical Submersible portable type pump**

These 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 monoblock type and shall be mounted on trolley and shall be suitable for handling water containing mud/sludge, solid particles, cotton waste, silica, ash particles, coal particles, polluted liquid etc. The particle size expected in water may be 30mm.

### **4.00.00      GENERAL PERFORMANCE REQUIREMENT**

|                                                                                   |                                |                                       |                 |
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|  | TITLE :                        | SPECIFICATION NO.: PE-TS-999-172-N001 |                 |
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- 4.01.00 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".
- 4.02.00 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.
- 4.03.00 Permanently installed vertical sump pumps/submersible pumps, wherever specified, shall be suitable for parallel operation. The head vs capacity, the bhp 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.
- 4.04.00 The static head requirement of portable type sump pumps 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, its drive shall be sufficiently rated to cater for any overloading during the pump operation at its minimum possible head, i.e. maximum discharge.
- 4.05.00 Pump with its drive unit shall run smooth without undue noise and vibration. Acceptable peak to peak vibration limits shall generally be guided by Hydraulic Institute Standards (latest edition)/as per applicable IS standard.
- 5.00.00 GENERAL**
- 5.01.00 Pumps as described in Section-IA/ID (DataSheet-A) shall be complete with their drives, couplings and other accessories as also those needed to make the pump sets complete in all respect, for proper operation and maintenance.
- 6.00.00 DESIGN AND CONSTRUCTION**
- 6.01.00 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 section and as per data sheet-A.
- 6.02.00 Each sump pump shall be equipped and coupled with a drive motor with rating so selected as to have atleast 25% margin over the maximum power required by the pump, throughout its range of operation.
- The discharge rate of sump pump is very much uncontrolled. As such pump should be capable to operate even under a condition of as low as 25% of specified total head.
- 6.03.00 All integral piping shall be as per IS-1239 of heavy grade (as suited for the maximum operating pressure) and shall be either galvanised or painted with approved rust inhibiting paint.
- 6.04.00 All valves shall be steel body type as per applicable IS/BA/ANSI standard, with pressure class compatible with the maximum working pressure.

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- 6.05.00 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 subject to in all working conditions, including hydrostatic testing of the sump pump discharge line.
- 6.06.00 Pump suction strainer (applicable only for Portable Horizontal Sump Pumps) shall have openings large enough just to permit the entry of solids having maximum size as stipulated in the specification.
- 6.07.00 Pressure gauges shall be of Bourdon type, with sealing diaphragm to prevent ingress of the work fluid. Selected range of pressure gauge shall be such that the entire range of working pressure covers about 1/3rd to 2/3rd to its range. Accuracy of measurement shall be within  $\pm 1\%$  of scale range. The suction pressure gauge shall be compound type. Pressure gauge dial size shall be 100mm or more.
- 6.08.00 Pumps**
- 6.08.01 Fixed type Sump Pumps 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.
- 6.08.02 Fixed duty type Submersible pumps shall be monoblock type in which electric motor shall be integral part of the pump and this monoblock of pump & motor set shall be submerged in the water. The pump shall be single stage and non-clog design.
- 6.08.03 Trolley mounted portable sump pumps 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.
- 6.08.04 Vertical Submersible Portable type pumps shall be submersible pump motor type, single stage and non-clog design and shall be portable type.
- 6.08.04 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 blow holes, sand holes, other detrimental defects. The casing shall be complete with suction and discharge connections.
- d) For submersible type sump pumps 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

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bearing.

- e) Trolley mounted portable sump pumps shall be provided with vent connections and drain connections with valves. These pumps shall be manually primed.

#### **6.08.05 Impeller**

- a) The impeller shall be 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 excessive maintenance.
- b) Impellers of Fixed type sump pumps shall have provision for adjustment from an accessible location.

#### **6.08.06 Pump shaft**

- a) Shaft size selected shall be such that critical speed is at least 20% away from the operating speed and the runway 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.

#### **6.08.07 Column Pipe for fixed type sump pumps (As applicable for vertical sump pumps)**

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.

#### **6.08.08 Bearings**

- a) Adequate nos. of properly designed bearings shall be furnished. Bearings for fixed type Sump Pumps shall be Oil lubricated and Bearings for trolley mounted Horizontal pumps shall be antifriction type and lubricated by oil/grease. 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 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 or oil from a location conveniently accessible. Design shall be such that the lubricant can not contaminate the

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handling liquid.

#### **6.08.09      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.

#### **6.08.10      Stuffing Box**

Stuffing box of Fixed type sump pumps shall be of mechanical packing type. Trolley mounted portable sump pumps shall have mechanical seal of reliable design.

#### **6.08.11      Coupling**

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

**6.08.12**      Fixed type sump pumps shall be provided with a suitable mounting plate. The mounting plate shall be adequately sized to accommodate the level switches, discharge pipe, oil cups etc. Trolley mounted portable sump pumps and drives shall be mounted on one base plate. Base plate shall be of rigid construction properly ribbed as needed. Suitable drain with valve, vent 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 alongwith anchor bolts, foundation bolts, pipe, sleeves etc. Lifting lug, eye bolts etc., as required for the proper handling of each pump set shall be furnished.

#### **6.08.13      Suction Bell**

Fixed type sump pumps and vertical submersible portable type pumps shall be complete with adequately dimensioned suction bell to guide and streamline intake fluid.

### **7.00.00      INSPECTION AND TESTING**

The contractor shall carry out the following minimum specific tests & inspections to ensure that the equipment furnished lies in strict conformance with the specification & in accordance with codes/standards and good engineering practice.

- a) Material identification and testing shall include but shall not be limited to the following components:
  - i) Impeller & wearing rings.

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- ii) Shafts & shaft sleeves.
  - iii) Couplings
  - iv) Bearings
  - v) Coloumn pipes
  - vi) Discharge head
- b) Tests shall also include but shall not be limited to the following :
- i) The entire surface of the impeller castings shall be subjected to D.P. test as per ASTM-E-165.
  - ii) Shaft shall be subject to D.P. & Ultrasonic test.
  - iii) Wearing rings shall be subject to D.P. test.
  - iv) Witnessing of NDT/review of NDT reports.
  - v) Static balance test for impeller & dynamic balance of complete rotating parts as per ISO-1940.
  - vi) Complete inspection of assembled pump
- c) Hydrostatic test shall be done for the following components (as minimum) at 150% of the shut-off pressure. Pressure shall be maintained for a period of not less than one (1) hour.
- i) Bowls/suction bells
  - ii) Column pipe
  - iii) Discharge head
  - iv) Any other applicable pressure parts.

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d) Performance tests at shop

- i) Each pump shall have to be tested to determine performance curves of the pumps. These tests are to be conducted in the presence of Owner's representative as per the requirements of the Standards of Hydraulic Institute of USA (ASME-Power Test Code PTC 8.2/BS-599) or any other equivalent standard but the tolerances on Head, Discharge & Power shall be specified in HIS, USA.
- ii) Performance tests are to be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 130% of rated capacity upto pump shut-off condition. A minimum of five combinations of head & capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation as specified in the annexures. After completion of performance test, all pumps shall be stripped down for inspection of internals.
- iii) Tests shall be conducted with actual drive motors being furnished
- iv) The Bidder shall submit in his proposal the facilities available at his works to conduct performance testing.
- v) NPSH tests are to be conducted on one pump of each type at 3% head drop conditions, if specified in the pump Annexures.
- vi) All rotating components of the pumps shall be subjected to static and dynamic balancing tests. The assembled rotor will be subjected to dynamic balancing tests.
- vii) Mechanical run test shall be carried out on all pumps to determine the vibration levels, noise levels etc. This test shall be conducted at site also. However, test value at site shall be used for the acceptance of the equipment.

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

7.02.00      Test on motors, control panels, starter panels, cables shall be conducted as per the requirement of this specification.

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

7.04.00      A typical quality plan is enclosed for bidder's guidance, the bidder shall furnish detailed Quality Plan based on same for Purchaser's approval, in the event of order.

**8.00.00      Drawings, data, curves and information**

8.01.00      Following drawings, data and information for the equipments are required to be submitted by the bidder alongwith his formal proposal.

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- 8.01.01 General Arrangement drawings of the pumps showing various dimensions, suction and discharge locations.
- 8.01.02 Typical cross-section drawings of the pumps, seal rings, etc., and materials of construction for all items.
- 8.01.03 Characteristic curves of pumps showing effective head, pump input power, efficiency, submergence and NPSH, against capacity ranging from shut off condition to 150% of rated capacity.
- 8.01.04 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.
- 8.01.05 Diagram showing the type of lubrication system etc.
- 8.01.06 Completely filled up schedules enclosed under Vol.III of this specification.
- 8.01.07 GA drawing of Control Panel.
- 8.01.08 A write up describing clearly the procedure for installing the pump and also for overhauling the fixed type pumps. A procedure for lowering and raising the vertical submersible portable type pumps shall also be given.
- 8.02.00 Drawings, data, curves and information to be submitted by the successful tenderer after placement of order.
- 8.02.01 The drawings/data asked against clause nos.8.01.00 to 8.01.07 above shall also be furnished in a finalised form by the successful tenderer for the approval of the purchaser/his consultant. In addition following documents shall also be submitted for Purchaser's/consultant's approval.
- 8.02.02 Pump foundation details with static and dynamic loads.
- 8.02.03 Pump and drive sealing, bearing lubrication and cooling arrangement drawing.
- 8.02.04 Drive data
- 8.02.05 Reports on shop tests and test certificates.
- 8.02.06 All other drawings/documents and data as specified and deemed necessary.



|                                                                                   |                                                             |                                                                                             |                                         |                                       |                                    |                                         |                                           |                         |                           |          |                     |          |                                                                                                |
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|  | <b>MANUFACTURER / BIDDER / SUPPLIER NAME &amp; ADDRESS:</b> |                                                                                             | <b>QUALITY PLAN</b>                     |                                       |                                    |                                         | <b>SPECIFICATION NO:</b>                  |                         | <b>PE-TS-426-100-N002</b> |          | <b>DATE</b>         |          |                                                                                                |
|                                                                                   |                                                             |                                                                                             | <b>CUSTOMER:</b>                        |                                       |                                    |                                         | QP NO.:                                   |                         | PE-QP-999-100-N005        |          | <b>REV:</b>         |          |                                                                                                |
|                                                                                   |                                                             |                                                                                             | <b>PROJECT:</b>                         |                                       |                                    |                                         | PO NO.:                                   |                         |                           |          |                     |          |                                                                                                |
|                                                                                   |                                                             |                                                                                             | <b>ITEM: Sump Pump/Submersible Pump</b> |                                       | <b>SYSTEM: Plant Water/ Common</b> |                                         | <b>SECTION:</b>                           |                         |                           |          | <b>SHEET 1 OF 2</b> |          |                                                                                                |
| <b>SR. NO</b>                                                                     | <b>COMPONENT &amp; OPERATIONS</b>                           | <b>CHARACTERISTICS</b>                                                                      | <b>CLASS</b>                            | <b>TYPE OF CHECK</b>                  | <b>QUANTUM OF CHECK</b>            | <b>REFERENCE DOCUMENT</b>               | <b>ACCEPTANCE NORM</b>                    | <b>FORMAT OF RECORD</b> | <b>AGENCY **</b>          |          |                     |          | <b>R E M A R K S</b>                                                                           |
| <b>1</b>                                                                          | <b>2</b>                                                    | <b>3</b>                                                                                    | <b>4</b>                                | <b>5</b>                              | <b>6</b>                           | <b>7</b>                                | <b>8</b>                                  | <b>9</b>                | <b>D*</b>                 | <b>M</b> | <b>C</b>            | <b>N</b> |                                                                                                |
| <b>1.0</b>                                                                        | <b>Raw Material and Bought out Control</b>                  |                                                                                             |                                         |                                       |                                    |                                         |                                           |                         |                           |          |                     |          |                                                                                                |
| 1.1a                                                                              | Pump Casing                                                 | Mechanical Properties - Tensile Strength & Hardness / Chemical Composition                  | CR                                      | Mechanical/ Chemical Analysis         | 1 / Heat / Batch                   | Approved Drawing/ Data sheet            | Relevant Material specification           | Lab Report/ MTC         | √                         | P        | V                   | V        |                                                                                                |
| 1.1b                                                                              | Impeller                                                    | Mechanical Properties - Tensile Strength, Yield Strength & Elongation, Chemical Composition | CR                                      | Mechanical/ Chemical Analysis         | 1 / Heat / Batch                   | Approved Drawing/ Data sheet            | Relevant Material specification           | Lab Report              | √                         | P        | V                   | V        |                                                                                                |
| 1.2                                                                               | Heat treatment of Stainless Steel Castings                  | Heat Cycle                                                                                  | MA                                      | Verification of HT chart              | All Batches                        | Relevant Material specification         | Relevant Material specification           | Corelated HT charts     | √                         | P        | V                   | V        |                                                                                                |
| 1.3                                                                               | Bars / forgings for pump and motor shafts                   | Mechanical/Chemical Properties                                                              | CR                                      | Mechanical/ Chemical Analysis         | 1 / Bar                            | Approved Drawing/ Data sheet            | Relevant Material specification           | Mill TC or lab report   | √                         | P        | V                   | V        |                                                                                                |
|                                                                                   |                                                             | Dimensions                                                                                  | MA                                      | Measurment                            | 100%                               | Manufacturers Drawing                   | Manufacturers Drawing                     | IR                      | √                         | P        | V                   | V        |                                                                                                |
|                                                                                   |                                                             | Internal defects for 40 mm and above diameter                                               | CR                                      | UT                                    | 100%                               | ASTM A-388                              | Refer Note 1                              | IR                      | √                         | P        | V                   | V        |                                                                                                |
| 1.4                                                                               | Cable Type: PVC insulated, multicore, copper conductor      | Routine TC and acceptance TC as per IS 694/Is1554, Length and size                          | MA                                      | Measurement                           | 100%                               | Approved Datasheet / IS 694/IS1554      | Approved Datasheet / IS 694/IS1555        | IR & TC                 | √                         | P        | V                   | V        | Compliance certificate to be submitted by Vendor                                               |
| 1.5                                                                               | Bearings                                                    | Make, Bearing No., Surface finish                                                           | MA                                      | Visual Examination                    | 100%                               | Approved data sheet/Manuf.standard      | Approved data sheet/Manuf.standard        | -                       | √                         | P        | V                   | V        | Compliance certificate to be submitted by Vendor                                               |
| <b>2.0</b>                                                                        | <b>Inprocess Control</b>                                    |                                                                                             |                                         |                                       |                                    |                                         |                                           |                         |                           |          |                     |          |                                                                                                |
| 2.1                                                                               | All Components                                              | Visual Defects                                                                              | MA                                      | Visual                                | 100%                               | Manufacturers Drawing                   | No harmful defects                        | Log book / IR           | √                         | P        | V                   | V        |                                                                                                |
|                                                                                   |                                                             | Dimensions                                                                                  | MA                                      | Measurement                           | 100%                               | Manufacturers Drawing                   | Manufacturers Drawing                     | Log book / IR           | √                         | P        | V                   | V        |                                                                                                |
| 2.2                                                                               | Pump discharge casing                                       | Leak tightness                                                                              | CR                                      | Hydro test (Duration 30 minutes min.) | 100%                               | Refer Remark.                           | No leakage                                | IR                      | √                         | P        | W                   | V        | Test Pressure=2 times duty point pressure OR 1.5 times pump shut off head, whichever is higher |
|                                                                                   | Motor Housing                                               | Leak tightness                                                                              | CR                                      | Air test (Duration 30 Minutes min)    | 100%                               | Air test at 0.5 kg/cm2 (guage pressure) | No leakage                                | IR                      | √                         | P        | V                   | V        |                                                                                                |
| 2.3                                                                               | Casing & Impeller (machined surfaces)                       | Surface Defects                                                                             | CR                                      | DPT                                   | 100%                               | ASTME:165                               | No Surface defect                         | IR                      | √                         | P        | V                   | V        | On machined surface only                                                                       |
| 2.4                                                                               | Impeller                                                    | Static & Dynamic residual unbalance                                                         | CR                                      | Static, Dynamic balancing             | 100%                               | ISO : 1940                              | ISO 1940 Gr. 6.3                          | IR                      | √                         | P        | V                   | V        |                                                                                                |
| 2.5                                                                               | Pump Motor Shaft                                            | Internal Defects                                                                            | CR                                      | UT                                    | 100%                               | ASTME:388                               | ASTME-388, Refer note1                    | IR                      | √                         | P        | V                   | V        | On machined surface only                                                                       |
|                                                                                   |                                                             | Surface Defects                                                                             | CR                                      | DPT                                   | 100%                               | ASTME:165                               | No Surface defect                         | IR                      | √                         | P        | V                   | V        | On machined surface only                                                                       |
| <b>BHARAT HEAVY ELECTRICALS LIMITED (BHEL)</b>                                    |                                                             |                                                                                             |                                         |                                       | <b>BIDDER/SUPPLIER</b>             |                                         | <b>FOR CUSTOMER REVIEW &amp; APPROVAL</b> |                         |                           |          |                     |          |                                                                                                |
| <b>ENGINEERING</b>                                                                |                                                             | <b>QUALITY</b>                                                                              |                                         |                                       | Sign & Date                        |                                         | DOC NO:                                   |                         |                           |          |                     |          |                                                                                                |
|                                                                                   | Sign & Date                                                 | Name                                                                                        | Sign & Date                             | Name                                  | Company Seal                       |                                         |                                           | Sign & Date             | Name                      | Seal     |                     |          |                                                                                                |
| Prepared by:                                                                      | Girish Chandra                                              | Checked by:                                                                                 | Mohit Kumar                             |                                       |                                    |                                         | Reviewed by:                              |                         |                           |          |                     |          |                                                                                                |
| Reviewed by:                                                                      | Vishal Kr. Yadav                                            | Reviewed by:                                                                                | Ritesh Kr. Jaiswal                      |                                       |                                    |                                         | Approved by:                              |                         |                           |          |                     |          |                                                                                                |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                             |                                                                       |                                         |                                                         |                                    |                                                                  |                                                  |                                         |           |                  |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>MANUFACTURER / BIDDER / SUPPLIER NAME &amp; ADDRESS:</b> |                                                                       | <b>QUALITY PLAN</b>                     |                                                         |                                    |                                                                  | <b>SPECIFICATION NO:</b>                         | <b>PE-TS-426-100-N002</b>               |           | <b>DATE</b>      |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                             |                                                                       | <b>CUSTOMER:</b>                        |                                                         |                                    |                                                                  | QP NO.:                                          | PE-QP-999-100-N005                      |           | <b>REV:</b>      |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                             |                                                                       | <b>PROJECT:</b>                         |                                                         |                                    |                                                                  | PO NO.:                                          |                                         |           |                  |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                             |                                                                       | <b>ITEM: Sump Pump/Submersible Pump</b> |                                                         | <b>SYSTEM: Plant Water/ Common</b> |                                                                  | <b>SECTION:</b>                                  |                                         |           |                  | <b>SHEET 2 OF 2</b> |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>SR. NO</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>COMPONENT &amp; OPERATIONS</b>                           | <b>CHARACTERISTICS</b>                                                | <b>CLASS</b>                            | <b>TYPE OF CHECK</b>                                    | <b>QUANTUM OF CHECK</b>            | <b>REFERENCE DOCUMENT</b>                                        | <b>ACCEPTANCE NORM</b>                           | <b>FORMAT OF RECORD</b>                 | <b>D*</b> | <b>AGENCY **</b> |                     |          |                                                                                             | <b>R E M A R K S</b>                           |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>2</b>                                                    | <b>3</b>                                                              | <b>4</b>                                | <b>5</b>                                                | <b>6</b>                           | <b>7</b>                                                         | <b>8</b>                                         | <b>9</b>                                | <b>D*</b> | <b>M</b>         | <b>C</b>            | <b>N</b> |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>3.0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Sub-Assembly, Assembly Control</b>                       |                                                                       |                                         |                                                         |                                    |                                                                  |                                                  |                                         |           |                  |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Pump, Motor, Rotor                                          | Eccentricity                                                          | MA                                      | Measurement                                             | 100%                               | Manufacturers Drawing                                            | Manufacturers Drawing                            | Log book / IR                           | √         | P                | V                   | V        |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Pump and Motor assembly                                     | Completeness, correctness                                             | MA                                      | Visual Examination                                      | 100%                               | Manufacturers Drawing                                            | Manufacturers Drawing                            | IR                                      | √         | P                | V                   | V        |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>4.0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Final Inspection, Test, Packing, Despatch Control</b>    |                                                                       |                                         |                                                         |                                    |                                                                  |                                                  |                                         |           |                  |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Pump set (Pump+ Motor)                                      | Q Vs Head, Q Vs Power, Q Vs Efficiency                                | CR                                      | Performance test                                        | 100%                               | Tech. Spec., Appd. Data Sheet, Appd. Curves, HIS, Test procedure | Tech. Spec., Appd. Data Sheet, Appd. Curves, HIS | Performance test record, Plotted Curves | √         | P                | W                   | V        |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Routine Test on motor                                       | HV, IR, Locked Rotor, No Load, Make type, Rating                      | CR                                      | Electrical tests                                        | 100%                               | IS 325                                                           | Approved Data Sheet                              | IR                                      | √         | P                | V                   | V        | Winding resistance **<br>Degree of protection shall be IP 68, HV at 2.5 KV AC for 1 Minute. |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Strip down after Performance test                           | Undue wear, tear and breakages                                        | CR                                      | Visual examination of Casing & Impeller after stripping | 100%                               | Undue wear, tear and breakages                                   | No undue wear, tear and breakages                | IR                                      | √         | P                | W                   | V        | Witnessing one no. of each type                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Complete Pump                                               | Completeness, Correctness, Workmanship and finish, overall dimensions | MA                                      | Visual examination                                      | 100%                               | Approved G.A. drawing                                            | Approved G.A. drawing                            | IR                                      | √         | P                | V                   | V        | Compliance report for accessories will be submitted.                                        |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Painting                                                    | Surface Finish, DFT, Markings etc.                                    | MA                                      | Visual examination, Measurement, Asthetic               | 100%                               | Approved data sheet/Manufacturer standard                        |                                                  | IR                                      | √         | P                | V                   | V        | Compliance report by Manufacturer                                                           |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Packing, Marking                                            | Soundness of Packing                                                  | MI                                      | Visual, Asthetic                                        | 100%                               | Technical Specification / Manufacture standard                   |                                                  | Photographs                             | √         | P                | V                   | -        | Photograph of packed material to be verified by BHEL before issuing MDCC.                   |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>Note :</b><br>1. For accessories and bought out items, Manufacturer will submit Compliance for review.<br>2. For UT test on shaft, defect echo < 20 % full screen height when back wall echo set @ 100 % screen height. Reduction in back wall echo to be <20%. Defect height > 20 % of FSH is not acceptable, also loss in backwall echo>20 % not acceptable.<br>3. IP 68 protection certificate for test conducted on similar motor shall be submitted for review.<br>4. Compliance for provision of thermic switch for over heating protection of winding, reverse rotation protection device shall be submitted by Manufacturer.<br>5. For control panel separate QAP is applicable.<br>6. Before sending the documents for approval, supplier to ensure that "Reference documents" & "acceptance Norms" does contain data required for the Characteristic to be checked" as indicated in QP.                                                                                                                                                         |                                                             |                                                                       |                                         |                                                         |                                    |                                                                  |                                                  |                                         |           |                  |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>LEGENDS:</b><br>* RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.<br><b>** M:</b> SUPPLIER/MANUFACTURER/ SUB-SUPPLIER, <b>C:</b> MAIN SUPPLIER/ BHEL / THIRDED PARTY INSPECTION AGENCY, <b>N:</b> CUSTOMER. <b>P:</b> PERFORM, <b>V:</b> VERIFICATION, <b>W:</b> WITNESS<br><b>MA:</b> MAJOR, <b>MI:</b> MINOR, <b>CR:</b> CRITICAL, <b>MTC:</b> MILL TEST CERTIFICATE, <b>TC:</b> TEST CERTIFICATE, <b>IR:</b> INSPECTION REPORT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                             |                                                                       |                                         |                                                         |                                    |                                                                  |                                                  |                                         |           |                  |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <table border="1"> <tr> <td colspan="4"><b>BHARAT HEAVY ELECTRICALS LIMITED (BHEL)</b></td> <td colspan="2"><b>BIDDER/SUPPLIER</b></td> <td colspan="6"><b>FOR CUSTOMER REVIEW &amp; APPROVAL</b></td> </tr> <tr> <td colspan="2"><b>ENGINEERING</b></td> <td colspan="3"><b>QUALITY</b></td> <td>Sign &amp; Date</td> <td></td> <td colspan="2">DOC NO:</td> <td colspan="4"></td> </tr> <tr> <td>Sign &amp; Date</td> <td>Name</td> <td></td> <td>Sign &amp; Date</td> <td>Name</td> <td rowspan="4">Company Seal</td> <td></td> <td colspan="2">Sign &amp; Date</td> <td colspan="2">Name</td> <td>Seal</td> </tr> <tr> <td>Prepared by:</td> <td>Girish Chandra</td> <td>Checked by:</td> <td></td> <td>Mohit Kumar</td> <td>Reviewed by:</td> <td colspan="2"></td> <td colspan="2"></td> <td></td> </tr> <tr> <td>Reviewed by:</td> <td>Vishal Kr. Yadav</td> <td>Reviewed by:</td> <td></td> <td>Ritesh Kr. Jaiswal</td> <td>Approved by:</td> <td colspan="2"></td> <td colspan="2"></td> <td></td> </tr> <tr> <td colspan="11"></td> </tr> </table> |                                                             |                                                                       |                                         |                                                         |                                    |                                                                  |                                                  |                                         |           |                  |                     |          |                                                                                             | <b>BHARAT HEAVY ELECTRICALS LIMITED (BHEL)</b> |  |  |  | <b>BIDDER/SUPPLIER</b> |  | <b>FOR CUSTOMER REVIEW &amp; APPROVAL</b> |  |  |  |  |  | <b>ENGINEERING</b> |  | <b>QUALITY</b> |  |  | Sign & Date |  | DOC NO: |  |  |  |  |  | Sign & Date | Name |  | Sign & Date | Name | Company Seal |  | Sign & Date |  | Name |  | Seal | Prepared by: | Girish Chandra | Checked by: |  | Mohit Kumar | Reviewed by: |  |  |  |  |  | Reviewed by: | Vishal Kr. Yadav | Reviewed by: |  | Ritesh Kr. Jaiswal | Approved by: |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>BHARAT HEAVY ELECTRICALS LIMITED (BHEL)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                             |                                                                       |                                         | <b>BIDDER/SUPPLIER</b>                                  |                                    | <b>FOR CUSTOMER REVIEW &amp; APPROVAL</b>                        |                                                  |                                         |           |                  |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>ENGINEERING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                             | <b>QUALITY</b>                                                        |                                         |                                                         | Sign & Date                        |                                                                  | DOC NO:                                          |                                         |           |                  |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sign & Date                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Name                                                        |                                                                       | Sign & Date                             | Name                                                    | Company Seal                       |                                                                  | Sign & Date                                      |                                         | Name      |                  | Seal                |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Prepared by:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Girish Chandra                                              | Checked by:                                                           |                                         | Mohit Kumar                                             |                                    | Reviewed by:                                                     |                                                  |                                         |           |                  |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Reviewed by:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Vishal Kr. Yadav                                            | Reviewed by:                                                          |                                         | Ritesh Kr. Jaiswal                                      |                                    | Approved by:                                                     |                                                  |                                         |           |                  |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                             |                                                                       |                                         |                                                         |                                    |                                                                  |                                                  |                                         |           |                  |                     |          |                                                                                             |                                                |  |  |  |                        |  |                                           |  |  |  |  |  |                    |  |                |  |  |             |  |         |  |  |  |  |  |             |      |  |             |      |              |  |             |  |      |  |      |              |                |             |  |             |              |  |  |  |  |  |              |                  |              |  |                    |              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |



TITLE:

**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**

**STANDARD TECHNICAL REQUIREMENTS**

SPEC. NO.: **PE-TS-426-100-N002**

SECTION: **II**

SUB-SECTION: **IIB**

REV. NO. **0** DATE **07.02.2020**

SHEET **1** OF **1**

**SUB-SECTION - IIB**

**STANDARD TECHNICAL SPECIFICATION (ELECTRICAL)**



TITLE :  
**GENERAL TECHNICAL REQUIREMENTS**  
  
**FOR**  
  
**LV MOTORS**

|                                         |
|-----------------------------------------|
| SPECIFICATION NO.<br>PE-SS-999-506-E101 |
| VOLUME NO. : <b>II-B</b>                |
| SECTION : <b>D</b>                      |
| REV NO. : <b>00</b> DATE : 29/08/2005   |
| SHEET : 1 OF 1                          |

## **GENERAL TECHNICAL REQUIREMENTS**

**FOR**

**LV MOTORS**

**SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00**

|                                                 |                                                                                            |                                         |
|-------------------------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------|
| <div><div>बी एच ई एल</div><div>BHEL</div></div> | TITLE :<br><b>GENERAL TECHNICAL REQUIREMENTS</b><br><br><b>FOR</b><br><br><b>LV MOTORS</b> | SPECIFICATION NO.<br>PE-SS-999-506-E101 |
|                                                 |                                                                                            | VOLUME NO. : <b>II-B</b>                |
|                                                 |                                                                                            | SECTION : <b>D</b>                      |
|                                                 |                                                                                            | REV NO. : <b>00</b> DATE : 29/08/2005   |
|                                                 |                                                                                            | SHEET : 1 OF 4                          |

1.0

**INTENT OF SPECIFIATION**

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer’s work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0

**CODES AND STANDARDS**

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

|           |                                                                                                              |
|-----------|--------------------------------------------------------------------------------------------------------------|
| IS:325    | Three phase Induction motors                                                                                 |
| IS : 900  | Code of practice for installation and maintenance of induction motors                                        |
| IS: 996   | Single phase small AC and universal motors                                                                   |
| IS: 4722  | Rotating Electrical machines                                                                                 |
| IS: 4691  | Degree of Protection provided by enclosures for rotating electrical machines                                 |
| IS: 4728  | Terminal marking and direction of rotation rotating electrical machines                                      |
| IS: 1231  | Dimensions of three phase foot mounted induction motors                                                      |
| IS: 8789  | Values of performance characteristics for three phase induction motors                                       |
| IS: 13555 | Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment |
| IS: 2148  | Flame proof enclosures for electrical appliance                                                              |
| IS: 5571  | Guide for selection of electrical equipment for hazardous areas                                              |
| IS: 12824 | Type of duty and classes of rating assigned                                                                  |
| IS: 12802 | Temperature rise measurement for rotating electrical machines                                                |
| IS: 12065 | Permissible limits of noise level for rotating electrical machines                                           |
| IS: 12075 | Mechanical vibration of rotating electrical machines                                                         |

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0

**DESIGN REQUIREMENTS**

3.1

Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2

Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information  
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3

**Starting Requirements**

3.3.1

Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2

Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

|                                                                                                                                                                                                                                                                                                                                         |                                                                                            |                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------|
|                                                                                                                                                                                                                                                         | TITLE :<br><b>GENERAL TECHNICAL REQUIREMENTS</b><br><br><b>FOR</b><br><br><b>LV MOTORS</b> | SPECIFICATION NO.<br>PE-SS-999-506-E101 |
|                                                                                                                                                                                                                                                                                                                                         |                                                                                            | VOLUME NO. : <b>II-B</b>                |
|                                                                                                                                                                                                                                                                                                                                         |                                                                                            | SECTION : <b>D</b>                      |
|                                                                                                                                                                                                                                                                                                                                         |                                                                                            | REV NO. : <b>00</b> DATE : 29/08/2005   |
|                                                                                                                                                                                                                                                                                                                                         |                                                                                            | SHEET : 2 OF 4                          |
| <p>The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.</p>                                                                                           |                                                                                            |                                         |
| <p>3.3.3 The following frequency of starts shall apply</p>                                                                                                                                                                                                                                                                              |                                                                                            |                                         |
| <p>i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.</p>                                                                                                                                                                                                            |                                                                                            |                                         |
| <p>ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)</p>                                                                                                                                     |                                                                                            |                                         |
| <p>iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor</p>                                                                 |                                                                                            |                                         |
| <p>3.4 <b>Running Requirements</b></p>                                                                                                                                                                                                                                                                                                  |                                                                                            |                                         |
| <p>3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.</p>                                                                                                                                                                           |                                                                                            |                                         |
| <p>3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.</p>                                                                                                                                                                             |                                                                                            |                                         |
| <p>3.5 <b>Stress During bus Transfer</b></p>                                                                                                                                                                                                                                                                                            |                                                                                            |                                         |
| <p>3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.</p> |                                                                                            |                                         |
| <p>3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.</p>                                                                                                                                                                                            |                                                                                            |                                         |
| <p>3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.</p>                                                                                                                                                                                          |                                                                                            |                                         |
| <p>3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.</p>                                                                                                                                                                         |                                                                                            |                                         |
| <p>4.0 <b>CONSTRUCTIONAL FEATURES</b></p>                                                                                                                                                                                                                                                                                               |                                                                                            |                                         |
| <p>4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy</p>                                                 |                                                                                            |                                         |
| <p>4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.</p>                                                                                                                                                                              |                                                                                            |                                         |
| <p>Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled</p>                                                                                                                                                                                                                                                          |                                                                                            |                                         |
| <p>4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.</p>                                                                                                                                                                                                                                         |                                                                                            |                                         |

|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                         |
|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
|  | TITLE :<br><b>GENERAL TECHNICAL REQUIREMENTS</b><br><br><b>FOR</b><br><br><b>LV MOTORS</b>                                                                                                                                                                                                                                                                                                                                                                             | SPECIFICATION NO.<br>PE-SS-999-506-E101 |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | VOLUME NO. : <b>II-B</b>                |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | SECTION : <b>D</b>                      |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | REV NO. : <b>00</b> DATE : 29/08/2005   |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | SHEET : 3 OF 4                          |
| 4.4.                                                                             | Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.                                                                                                                                                                                                                                                                                                                                                              |                                         |
| 4.5                                                                              | Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.                                                                                                                                                                                                                                                                                                                          |                                         |
| 4.6                                                                              | In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation.<br>In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.                                                                                                                                                                     |                                         |
| 4.7                                                                              | <b>Terminals and Terminal Boxes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                         |
| 4.7.1                                                                            | Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.<br><br>Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”. |                                         |
| 4.7.2                                                                            | unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.                                                                                                                                                                                                                                                                                         |                                         |
| 4.7.3                                                                            | Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.                                                                                                   |                                         |
| 4.7.4                                                                            | Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.                                                                                                                                                                                                                                             |                                         |
| 4.7.5                                                                            | Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.                                                                                                                                                                                                                                |                                         |
| 4.7.6                                                                            | Degree of protection for terminal boxes shall be IP 55 as per IS 4691.                                                                                                                                                                                                                                                                                                                                                                                                 |                                         |
| 4.7.7                                                                            | Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.                                                                                                                                              |                                         |
| 4.7.8.                                                                           | Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.                                                                                                                                                                                                                                                                                                                                                                 |                                         |
| 4.7.9                                                                            | Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.                                                                                                                                                                                                                                                                                                                       |                                         |
| 4.8                                                                              | Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.                                                                                                                                                                                                                                      |                                         |
| 4.9                                                                              | <b>General</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                         |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                            |                                         |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                            | VOLUME NO. : <b>II-B</b>                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                            | SECTION : <b>D</b>                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                            | REV NO. : <b>00</b> DATE : 29/08/2005   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                            | SHEET : 4 OF 4                          |
| <p>4.9.1 Motors provided for similar drives shall be interchangeable.</p> <p>4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.</p> <p>4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.</p> <p>4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.</p> <p>4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.</p> <p>4.9.6 Name plate with all particulars as per IS: 325 shall be provided</p> <p>4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.</p> <p>5.0 <b>INSPECTION AND TESTING</b></p> <p>5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.</p> <p>5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.</p> <p>5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.</p> <p>5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.</p> <p>6.0 <b>DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT</b></p> <p>a) OGA drawing showing the position of terminal boxes, earthing connections etc.</p> <p>b) Arrangement drawing of terminal boxes.</p> <p>c) Characteristic curves:<br/>(To be given for motor above 55 kW unless otherwise specified in Data Sheet).</p> <p>i) Current vs. time at rated voltage and minimum starting voltage.</p> <p>ii) Speed vs. time at rated voltage and minimum starting voltage.</p> <p>iii) Torque vs. speed at rated voltage and minimum voltage.<br/>For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.</p> <p>iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.</p> |                                                                                            |                                         |



# QUALITY PLAN FOR MOTORS BELOW 55 KW (LV)

|         |                     |                                                                          |             |                                       |                 |                                                     |                                                |                  |                        |            |   |                        |
|---------|---------------------|--------------------------------------------------------------------------|-------------|---------------------------------------|-----------------|-----------------------------------------------------|------------------------------------------------|------------------|------------------------|------------|---|------------------------|
|         |                     | QUALITY PLAN                                                             |             | CUSTOMER :                            |                 | PROJECT                                             |                                                |                  | SPECIFICATION :        |            |   |                        |
|         |                     |                                                                          |             | BIDDER/ :                             |                 | TITLE                                               |                                                |                  | NUMBER :               |            |   |                        |
|         |                     | SHEET 1 OF 2                                                             |             | VENDOR                                |                 | QUALITY PLAN<br>NUMBER PED-506-00-Q-006, REV-01     |                                                |                  | SPECIFICATION<br>TITLE |            |   |                        |
|         |                     | SYSTEM                                                                   |             | ITEM AC ELECT. MOTORS BELOW 55KW (LV) |                 |                                                     | SECTION                                        |                  |                        | VOLUME III |   |                        |
| SL. NO. | COMPONENT/OPERATION | CHARACTERISTICS CHECK                                                    | CAT.        | TYPE/METHOD OF CHECK                  | EXTENT OF CHECK | REFERENCE DOCUMENT                                  | ACCEPTANCE NORM                                | FORMAT OF RECORD | AGENCY                 |            |   | REMARKS                |
|         |                     |                                                                          |             |                                       |                 |                                                     |                                                |                  | P                      | W          | V |                        |
| 1       | 2                   | 3                                                                        | 4           | 5                                     | 6               | 7                                                   | 8                                              | 9                | 10                     |            |   | 11                     |
| 1.0     | ASSEMBLY            | 1.WORKMANSHIP                                                            | MA          | VISUAL                                | 100%            | MANUF'S SPEC                                        | MANUF'S SPEC                                   | -DO-             | 2                      | -          | - |                        |
|         |                     | 2.DIMENSIONS                                                             | MA          | -DO-                                  | -DO-            | MFG. DRG./<br>MFG. SPEC.                            | MFG. DRG./<br>MFG. SPEC.                       | -DO-             | 2                      | -          | - |                        |
|         |                     | 3.CORRECTNESS<br>COMPLETENESS<br>TERMINATIONS/<br>MARKING/COLOUR<br>CODE | MA          | VISUAL                                | 100%            | MFG.SPEC./<br>RELEVANT IS                           | MFG.SPEC.<br>RELEVANT IS                       | -DO-             | 2                      | -          | - |                        |
| 2.0     | PAINTING            | 1.SHADE                                                                  | MA          | VISUAL                                | SAMPLE          | MANUFR'S<br>SPEC/BHEL<br>SPEC./RELEVANT<br>STANDARD | BHEL SPEC.<br>SAME AS<br>COL.7                 | LOG BOOK         | 2                      | -          | - |                        |
| 3.0     | TESTS               | 1.ROUTINE<br>TEST INCLUDING<br>SPECIAL TEST<br>AS PER BHEL<br>SPEC.      | MA          | -DO-                                  | 100%            | IS-325/<br>BHEL SPEC./<br>DATA SHEET                | SAME AS<br>COL.7                               | TEST<br>REPORT   | 2                      | 1          |   | NOTE -1<br>&<br>NOTE-3 |
|         |                     | 2.OVERALL<br>DIMENSIONS &<br>ORIENTATION                                 | MA          | MEASUREMENT<br>&<br>VISUAL            | 100%            | APPROVED<br>DRG/DATA<br>SHEET                       | APPROVED<br>DRG/DATA<br>SHEET<br>& RELEVANT IS | INSPN.<br>REPORT | 2                      | 1          | - | NOTE -1<br>&<br>NOTE-3 |
| BHEL    |                     |                                                                          | PARTICULARS |                                       |                 | BIDDER/VENDOR                                       |                                                |                  |                        |            |   |                        |
|         |                     |                                                                          | NAME        |                                       |                 |                                                     |                                                |                  |                        |            |   |                        |
|         |                     |                                                                          | SIGNATURE   |                                       |                 |                                                     |                                                |                  |                        |            |   |                        |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>QUALITY PLAN</b> |                       | CUSTOMER :          |                      |                 | PROJECT<br>TITLE                                |                     |                  | SPECIFICATION :<br>NUMBER :   |   |            |         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------|---------------------|----------------------|-----------------|-------------------------------------------------|---------------------|------------------|-------------------------------|---|------------|---------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                       | BIDDER/ :<br>VENDOR |                      |                 | QUALITY PLAN<br>NUMBER PED-506-00-Q-006, REV-01 |                     |                  | SPECIFICATION :<br>TITLE :    |   |            |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | SHEET 2 OF 2        |                       | SYSTEM              |                      |                 | ITEM AC ELECT. MOTORS BELOW 55KW (LV)           |                     |                  | SECTION                       |   | VOLUME III |         |
| SL. NO.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | COMPONENT/OPERATION | CHARACTERISTICS CHECK | CAT.                | TYPE/METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT                              | ACCEPTANCE NORM     | FORMAT OF RECORD | AGENCY                        |   |            | REMARKS |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2                   | 3                     | 4                   | 5                    | 6               | 7                                               | 8                   | 9                | P                             | W | V          | 11      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     | 3.NAMEPLATE DETAILS   | MA                  | VISUAL               | 100%            | IS-325 & DATA SHEET                             | IS-325 & DATA SHEET | INSPN. REPORT    | 2                             | 1 | -          |         |
| <p>NOTES:</p> <p>1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON</p> <p>2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p>3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.</p> <p><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER<br/>2. VENDOR (MOTOR MANUFACTURER)<br/>3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</p> <p>P. PERFORM<br/>W. WITNESS<br/>V. VERIFY</p> |                     |                       |                     |                      |                 |                                                 |                     |                  |                               |   |            |         |
| BHEL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                       | PARTICULARS         |                      |                 | BIDDER/VENDOR                                   |                     |                  |                               |   |            |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                       | NAME                |                      |                 |                                                 |                     |                  |                               |   |            |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                       | SIGNATURE           |                      |                 |                                                 |                     |                  |                               |   |            |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                       | DATE                |                      |                 |                                                 |                     |                  | BIDDER'S/VENDORS COMPANY SEAL |   |            |         |

# QUALITY PLAN FOR MOTORS 55 KW & ABOVE

|         |                                        |                                  |             |                       |                 |                        |                                                |                    |                               |                          |   |                                                       |
|---------|----------------------------------------|----------------------------------|-------------|-----------------------|-----------------|------------------------|------------------------------------------------|--------------------|-------------------------------|--------------------------|---|-------------------------------------------------------|
|         |                                        | QUALITY PLAN                     |             | CUSTOMER :            |                 |                        | PROJECT TITLE                                  |                    |                               | SPECIFICATION : NUMBER : |   |                                                       |
|         |                                        |                                  |             | BIDDER/ VENDOR :      |                 |                        | QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03   |                    |                               | SPECIFICATION : TITLE    |   |                                                       |
|         |                                        | SHEET 1 OF 9                     |             | SYSTEM                |                 |                        | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV) |                    |                               | SECTION                  |   | VOLUME III                                            |
| SL. NO. | COMPONENT/OPERATION                    | CHARACTERISTIC CHECK             | CAT.        | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT     | ACCEPTANCE NORM                                | FORMAT OF RECORD   | AGENCY                        |                          |   | REMARKS                                               |
| 1       | 2                                      | 3                                | 4           | 5                     | 6               | 7                      | 8                                              | 9                  | P                             | W                        | V | 11                                                    |
| 1.0     | RAW MATERIAL & BOUGHT OUT CONTROL      |                                  |             |                       |                 |                        |                                                |                    |                               |                          |   |                                                       |
| 1.1     | SHEET STEEL, PLATES, SECTION, EYEBOLTS | 1.SURFACE CONDITION              | MA          | VISUAL                | 100%            | -                      | FREE FROM BLINKS, CRACKS, WAVINESS ETC         | LOG BOOK           | 3                             | -                        | - |                                                       |
|         |                                        | 2.DIMENSIONS                     | MA          | MEASUREMENT           | SAMPLE          | MANFR'S DRG./SPEC      | MANFR'S DRG./SPEC                              | -DO-               | 3                             | -                        | - |                                                       |
|         |                                        | 3.PROOF LOAD TEST (EYE BOLT)     | MA          | MECH. TEST            | -DO-            | -DO-                   | -DO-                                           | INSPEC. REPORT     | 3                             | -                        | 2 |                                                       |
| 1.2     | HARDWARES                              | 1.SURFACE CONDITION              | MA          | VISUAL                | 100%            |                        | FREE FROM CRACKS, UN-EVENNESS ETC.             | -DO-               | 3                             | -                        | - |                                                       |
|         |                                        | 2.PROPERTY CLASS                 | MA          | VISUAL                | SAMPLES         | MANFR'S DRG./SPEC BOOK | RELEVENT IS/SPEC.                              | SUPPLIERS TC & LOG | 3                             | -                        | 2 | PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR |
| 1.3     | CASTING                                | 1.SURFACE CONDITION              | MA          | VISUAL                | 100%            |                        | FREE FROM CRACKS, BLOW HOLES ETC.              | LOG BOOK           | 3                             | -                        | 2 |                                                       |
|         |                                        | 2.CHEM. & PHY. PROP.             | MA          | CHEM & MECH TEST      | 1/HEAT NO.      | MANFR'S DRG./SPEC      | RELEVENT IS/                                   | SUPPLIER'S TC      | 3                             | -                        | 2 | HEAT NO. SHALL BE VERIFIED                            |
|         |                                        | 3.DIMENSIONS                     | MA          | MEASUREMENT           | 100%            | MANUFR'S DRG.          | MANUFR'S DRG.                                  | LOG BOOK           | 3                             | -                        | 2 |                                                       |
| 1.4     | PAINT & VARNISH                        | 1.MAKE, SHADE, SHELF LIFE & TYPE | MA          | VISUAL                | 100% CONTINUOUS | MANFR'S DRG./SPEC      | MANFR'S DRG./SPEC                              | LOG BOOK           | 3                             | -                        | 2 |                                                       |
| BHEL    |                                        |                                  | PARTICULARS |                       |                 | BIDDER/VENDOR          |                                                |                    |                               |                          |   |                                                       |
|         |                                        |                                  | NAME        |                       |                 |                        |                                                |                    |                               |                          |   |                                                       |
|         |                                        |                                  | SIGNATURE   |                       |                 |                        |                                                |                    |                               |                          |   |                                                       |
|         |                                        |                                  | DATE        |                       |                 |                        |                                                |                    | BIDDER'S/VENDORS COMPANY SEAL |                          |   |                                                       |

|                                                                                   |                                                                                                           |                                    |             |                                                |                                       |                      |                                              |                               |                 |            |   |                                                      |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------------|-------------|------------------------------------------------|---------------------------------------|----------------------|----------------------------------------------|-------------------------------|-----------------|------------|---|------------------------------------------------------|
|  |                                                                                                           | <b>QUALITY PLAN</b>                |             | CUSTOMER :                                     |                                       | PROJECT              |                                              |                               | SPECIFICATION : |            |   |                                                      |
|                                                                                   |                                                                                                           |                                    |             | BIDDER/                                        |                                       | TITLE                |                                              |                               | NUMBER :        |            |   |                                                      |
|                                                                                   |                                                                                                           |                                    |             | VENDOR                                         |                                       | QUALITY PLAN         |                                              |                               | SPECIFICATION : |            |   |                                                      |
| SHEET 2 OF 9                                                                      |                                                                                                           | SYSTEM                             |             | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV) |                                       |                      | SECTION                                      |                               |                 | VOLUME III |   |                                                      |
| SL. NO.                                                                           | COMPONENT/OPERATION                                                                                       | CHARACTERISTIC CHECK               | CAT.        | TYPE/ METHOD OF CHECK                          | EXTENT OF CHECK                       | REFERENCE DOCUMENT   | ACCEPTANCE NORM                              | FORMAT OF RECORD              | AGENCY          |            |   | REMARKS                                              |
|                                                                                   |                                                                                                           |                                    |             |                                                |                                       |                      |                                              |                               | P               | W          | V |                                                      |
| 1                                                                                 | 2                                                                                                         | 3                                  | 4           | 5                                              | 6                                     | 7                    | 8                                            | 9                             | 10              |            |   | 11                                                   |
| 1.5                                                                               | SHAFT<br>(FORGED OR ROLLED)                                                                               | 1. SURFACE COND.                   | MA          | VISUAL                                         | 100%                                  | -                    | FREE FROM VISUAL DEFECTS                     | -DO-                          | 3               | -          | - | VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED |
|                                                                                   |                                                                                                           | 2. CHEM. & PHYSICAL PROPERTIES     | MA          | CHEM. & PHYSICAL TESTS                         | 1/HEAT NO. OR HEAT TREATMENT BATCH NO | MFG. DRG. SPEC.      | RELEVANT IS                                  | SUPPLIER'S TC                 | 3               | -          | 2 |                                                      |
|                                                                                   |                                                                                                           | 3. DIMENSIONS                      | MA          | MEASUREMENT                                    | 100%                                  | -DO-                 | MANUFR'S DRG.                                | LOG BOOK                      | 3               | -          | 2 |                                                      |
|                                                                                   |                                                                                                           | 4.INTERNAL FLAWS                   | CR          | UT                                             | -DO-                                  | ASTM-A388            | MANUFR'S SPEC. BHEL SPEC.                    | -DO-                          | 3               | 2          | 1 |                                                      |
| 1.6                                                                               | SPACE HEATERS, CONNNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S | 1. MAKE & RATING                   | MA          | VISUAL                                         | -DO-                                  | MANUFR'S DRG. SPEC.  | MANUFR'S DRG. SPEC.                          | -DO-                          | 3               | -          | 2 | FOR DIA OF 55 MM & ABOVE                             |
|                                                                                   |                                                                                                           | 2. PHYSICAL COND.                  | MA          | -DO-                                           | -DO-                                  | -                    | NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY | -DO-                          | 3               | -          | 2 |                                                      |
|                                                                                   |                                                                                                           | 3.DIMENSIONS (WHEREVER APPLICABLE) | MA          | MEASUREMENT                                    | SAMPLE                                | MANUFR'S DRG./ SPEC. | MANUFR'S DRG. / SPEC.                        | -DO-                          | 3               | -          | 2 |                                                      |
|                                                                                   |                                                                                                           | 4.PERFORMANCE/ CALIBRATION         | MA          | TEST                                           | 100%                                  | -DO-                 | -DO-                                         | INSP. REPORT                  | 3               | -          | 2 |                                                      |
| BHEL                                                                              |                                                                                                           |                                    | PARTICULARS |                                                | BIDDER/VENDOR                         |                      |                                              |                               |                 |            |   |                                                      |
|                                                                                   |                                                                                                           |                                    | NAME        |                                                |                                       |                      |                                              |                               |                 |            |   |                                                      |
|                                                                                   |                                                                                                           |                                    | SIGNATURE   |                                                |                                       |                      |                                              |                               |                 |            |   |                                                      |
|                                                                                   |                                                                                                           |                                    | DATE        |                                                |                                       |                      |                                              | BIDDER'S/VENDORS COMPANY SEAL |                 |            |   |                                                      |

|                                                                                              |                                                                                    |                                    |             |                          |                 |                                    |                                    |                                                                                                   |                               |                 |         |                                                                              |
|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------|-------------|--------------------------|-----------------|------------------------------------|------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------|-----------------|---------|------------------------------------------------------------------------------|
| <div></div> |                                                                                    | QUALITY PLAN                       |             | CUSTOMER :               |                 |                                    | PROJECT                            |                                                                                                   |                               | SPECIFICATION : |         |                                                                              |
|                                                                                              |                                                                                    |                                    |             | BIDDER/ : VENDOR         |                 |                                    | TITLE                              |                                                                                                   |                               | NUMBER :        |         |                                                                              |
|                                                                                              |                                                                                    | SHEET 3 OF 9                       |             |                          | SYSTEM          |                                    |                                    | QUALITY PLAN<br>NUMBER PED-506-00-Q-007, REV-03<br>ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV) |                               |                 | SECTION |                                                                              |
| SL. NO.                                                                                      | COMPONENT/OPERATION                                                                | CHARACTERISTIC CHECK               | CAT.        | TYPE/<br>METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT                 | ACCEPTANCE NORM                    | FORMAT OF RECORD                                                                                  | AGENCY                        |                 |         | REMARKS                                                                      |
|                                                                                              |                                                                                    |                                    |             |                          |                 |                                    |                                    |                                                                                                   | P                             | W               | V       |                                                                              |
| 1                                                                                            | 2                                                                                  | 3                                  | 4           | 5                        | 6               | 7                                  | 8                                  | 9                                                                                                 | 10                            |                 |         | 11                                                                           |
| 1.7                                                                                          | OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC. | 1. SURFACE COND. ETC.              | MA          | VISUAL                   | 100%            | -                                  | NO VISUAL DEFECTS                  | INSPT. REPORT                                                                                     | 3                             | -               | 2       | FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT |
|                                                                                              |                                                                                    | 2. OTHER CHARACTERISTICS           | MA          | TEST                     | SAMPLE          | MANUF'S SPEC.                      | MANUF'S SPEC.                      | LOG BOOK AND OR SUPPLIER'S TC                                                                     | 3                             | -               | 2       |                                                                              |
| 1.8                                                                                          | SHEET STAMPING (PUNCHED)                                                           | 1. SURFACE COND.                   | MA          | VISUAL                   | 100%            | -                                  | NO VISUAL DEFECTS (FREE FROM BURS) | LOG BOOK                                                                                          | 3                             | -               | -       |                                                                              |
|                                                                                              |                                                                                    | 2.DIMENSIONS INCLUDING BURS HEIGHT | MA          | MEASUREMENT              | SAMPLE          | MANUFR'S DRG. .                    | MANUFR'S DRG.                      | -DO-                                                                                              | 3                             | -               | 2       |                                                                              |
|                                                                                              |                                                                                    | 3. ACCEPTANCE TESTS                | MA          | ELECT. & MECH TESTS      | -DO-            | MANUF'S SPEC./ RELEVANT IS         | RELEVANT IS                        | SUPPLIER'S TC                                                                                     | 3                             | -               | 2       |                                                                              |
| 1.9                                                                                          | CONDUCTORS                                                                         | 1. SURFACE FINISH                  | MA          | VISUAL                   | 100%            | -                                  | FREE FROM VISUAL DEFECTS           | LOG BOOK                                                                                          | 3*                            | -               | 2*      |                                                                              |
|                                                                                              |                                                                                    | 2.ELECT. PROP. & MECH. PROP        | MA          | ELECT. & MECH.TEST       | SAMPLES         | RELEVANT IS/ BS OR OTHER STANDARDS | RELEVANT IS/ BS OR OTHER STANDARDS | SUPPLIERS TC & VENDOR'S INSPN. REPORTS                                                            | 3                             | -               | 2       |                                                                              |
| BHEL                                                                                         |                                                                                    |                                    | PARTICULARS |                          |                 | BIDDER/VENDOR                      |                                    |                                                                                                   |                               |                 |         |                                                                              |
|                                                                                              |                                                                                    |                                    | NAME        |                          |                 |                                    |                                    |                                                                                                   |                               |                 |         |                                                                              |
|                                                                                              |                                                                                    |                                    | SIGNATURE   |                          |                 |                                    |                                    |                                                                                                   |                               |                 |         |                                                                              |
|                                                                                              |                                                                                    |                                    | DATE        |                          |                 |                                    |                                    |                                                                                                   | BIDDER'S/VENDORS COMPANY SEAL |                 |         |                                                                              |

|  |                                 | <b>QUALITY PLAN</b>        |             | CUSTOMER :            |                 | PROJECT TITLE                                  |                                            |                  | SPECIFICATION : NUMBER :      |   |            |         |
|-----------------------------------------------------------------------------------|---------------------------------|----------------------------|-------------|-----------------------|-----------------|------------------------------------------------|--------------------------------------------|------------------|-------------------------------|---|------------|---------|
|                                                                                   |                                 |                            |             | BIDDER/ VENDOR :      |                 | QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03   |                                            |                  | SPECIFICATION : TITLE         |   |            |         |
|                                                                                   |                                 | SHEET 4 OF 9               |             | SYSTEM                |                 | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV) |                                            |                  | SECTION                       |   | VOLUME III |         |
| SL. NO.                                                                           | COMPONENT/OPERATION             | CHARACTERISTIC CHECK       | CAT.        | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT                             | ACCEPTANCE NORM                            | FORMAT OF RECORD | AGENCY                        |   |            | REMARKS |
| 1                                                                                 | 2                               | 3                          | 4           | 5                     | 6               | 7                                              | 8                                          | 9                | 10                            |   |            | 11      |
| 1.10                                                                              | BEARINGS                        | 3.DIMENSIONS               | MA          | MEASUREMENT           | -DO-            | -DO-                                           | -DO-                                       | Log Book         | 3                             | - | 2          |         |
|                                                                                   |                                 | 1.MAKE & TYPE              | MA          | VISUAL                | 100%            | MANFR'S DRG./ APPROVED DATASHEET               | MANFR'S DRG./ APPROVED DATASHEET           | -DO-             | 3                             | - | 2          |         |
|                                                                                   |                                 | 2.DIMENSIONS               | MA          | MEASUREMENT           | SAMPLE          | BHEL DATA SHEET                                | BHEL DATA SHEET BEARING MANUF'S CATALOGUES | -DO-             | 3                             | - | 2          |         |
|                                                                                   |                                 | 3.SURFACE FINISH           | MA          | VISUAL                | 100%            | -                                              | FREE FROM VISUAL DEFECTS                   | -DO-             | 3                             | - | 2          |         |
| 1.11                                                                              | SLIP RING (WHEREVER APPLICABLE) | 1.SURFACE COND.            | MA          | VISUAL                | 100%            | -                                              | -DO-                                       | -DO-             | 3                             | - | -          |         |
|                                                                                   |                                 | 2.DIMENSIONS               | MA          | MEASUREMENT           | SAMPLE          | MANUF'S DRG                                    | MANUF'S DRG                                | -DO-             | 3                             | - | -          |         |
|                                                                                   |                                 | 3.TEMP.WITH-STAND CAPACITY | MA          | ELECT.TEST            | -DO-            | MANUF'S SPEC./ BHEL SPEC.                      | MANUF'S SPEC./ BHEL SPEC.                  | -DO-             | 3                             | - | 2          |         |
|                                                                                   |                                 | 4.HV/IR                    | MA          | -DO-                  | 100%            | -DO-                                           | -DO-                                       | -DO-             | 3                             | - | 2          |         |
| 1.12                                                                              | OIL SEALS & GASKETS             | 1.MATERIAL OF GASKET       | MA          | VISUAL                | 100%            | MANUF'S DRG/SPECS                              | MANUF'S DRG./ SPECS.                       | -DO-             | 3                             | - | -          |         |
|                                                                                   |                                 | 2.SURFACE COND.            | MA          | VISUAL                | 100%            | -                                              | FREE FROM VISUAL DEFECTS                   | -DO-             | 3                             | - | -          |         |
|                                                                                   |                                 | 3.DIMENSIONS               | MA          | MEASUREMENT           | SAMPLE          | MANUF'S DRG                                    | MANUF'S DRG                                | -DO-             | 3                             | - | -          |         |
| BHEL                                                                              |                                 |                            | PARTICULARS |                       | BIDDER/VENDOR   |                                                |                                            |                  |                               |   |            |         |
|                                                                                   |                                 |                            | NAME        |                       |                 |                                                |                                            |                  |                               |   |            |         |
|                                                                                   |                                 |                            | SIGNATURE   |                       |                 |                                                |                                            |                  |                               |   |            |         |
|                                                                                   |                                 |                            | DATE        |                       |                 |                                                |                                            |                  | BIDDER'S/VENDORS COMPANY SEAL |   |            |         |

|                                                                                   |                                                         |                                               |             |                                                |                 |                                         |                            |                  |                               |   |   |         |
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|  |                                                         | <b>QUALITY PLAN</b>                           |             | CUSTOMER :                                     |                 | PROJECT                                 |                            |                  | SPECIFICATION :               |   |   |         |
|                                                                                   |                                                         |                                               |             | BIDDER/ :                                      |                 | TITLE                                   |                            |                  | NUMBER :                      |   |   |         |
|                                                                                   |                                                         | SHEET 5 OF 9                                  |             | VENDOR                                         |                 | QUALITY PLAN                            |                            |                  | SPECIFICATION :               |   |   |         |
|                                                                                   |                                                         | SYSTEM                                        |             | NUMBER PED-506-00-Q-007, REV-03                |                 |                                         | TITLE                      |                  |                               |   |   |         |
|                                                                                   |                                                         |                                               |             | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV) |                 |                                         | SECTION                    |                  | VOLUME III                    |   |   |         |
| SL. NO.                                                                           | COMPONENT/OPERATION                                     | CHARACTERISTIC CHECK                          | CAT.        | TYPE/METHOD OF CHECK                           | EXTENT OF CHECK | REFERENCE DOCUMENT                      | ACCEPTANCE NORM            | FORMAT OF RECORD | AGENCY                        |   |   | REMARKS |
|                                                                                   |                                                         |                                               |             |                                                |                 |                                         |                            |                  | P                             | W | V |         |
| 1                                                                                 | 2                                                       | 3                                             | 4           | 5                                              | 6               | 7                                       | 8                          | 9                | 10                            |   |   | 11      |
| 2.0                                                                               | IN PROCESS                                              |                                               |             |                                                |                 |                                         |                            |                  |                               |   |   |         |
| 2.1                                                                               | STATOR FRAME WELDING<br>(IN CASE OF FABRICATED STATOR ) | 1.WORKMANSHIP & CLEANNES                      | MA          | VISUAL                                         | 100%            | -DO-                                    | GOOD FINISH                | LOG BOOK         | 3/2                           | 2 | - |         |
|                                                                                   |                                                         | 2.DIMENSIONS                                  | MA          | MEASUREMENT                                    | -DO-            | MANUF'S DRG                             | MANUF'S DRG                | -DO-             | 2                             | - | - |         |
| 2.2                                                                               | MACHINING                                               | 1.FINISH                                      | MA          | VISUAL                                         | 100%            | -DO-                                    | GOOD FINISH                | LOG BOOK         | 2                             | - | - |         |
|                                                                                   |                                                         | 2.DIMENSIONS                                  | MA          | MEASUREMENT                                    | -DO-            | MANUF'S DRG                             | MANUF'S DRG                | -DO-             | 2                             | - | - |         |
|                                                                                   |                                                         | 3.SHAFT SURFACE FLOWS                         | MA          | PT                                             | -DO-            | RELEVANT SPEC./ ASTM-E165               | MANUF'S SPEC./ BHEL SPEC./ | -DO-             | 2                             | - | 1 |         |
| 2.3                                                                               | PAINTING                                                | 1.SURFACE PREPARATION                         | MA          | VISUAL                                         | 100%            | MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND | BHEL SPEC. SAME AS COL.7   | LOG BOOK         | 2                             | - | - |         |
|                                                                                   |                                                         | 2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT) | MA          | MEASUREMENT BY ELCOMETER                       | SAMPLE          | -DO-                                    | -DO-                       | -DO-             | 2                             | - | - |         |
|                                                                                   |                                                         | 3.SHADE                                       | MA          | VISUAL                                         | -DO-            | -DO-                                    | -DO-                       | Log Book         | 2                             | - | - |         |
|                                                                                   |                                                         | 4.ADHESION                                    | MA          | CROSS CUTTING & TAPE TEST                      | -DO-            | -DO-                                    | -DO-                       | Log Book         | 2                             | - | - |         |
| BHEL                                                                              |                                                         |                                               | PARTICULARS |                                                | BIDDER/VENDOR   |                                         |                            |                  |                               |   |   |         |
|                                                                                   |                                                         |                                               | NAME        |                                                |                 |                                         |                            |                  |                               |   |   |         |
|                                                                                   |                                                         |                                               | SIGNATURE   |                                                |                 |                                         |                            |                  |                               |   |   |         |
|                                                                                   |                                                         |                                               | DATE        |                                                |                 |                                         |                            |                  | BIDDER'S/VENDORS COMPANY SEAL |   |   |         |

|  |                     | <b>QUALITY PLAN</b>                    |             | CUSTOMER :               |                 |                           | PROJECT TITLE                                   |                  | SPECIFICATION :<br>NUMBER :   |         |              |                                                         |
|-----------------------------------------------------------------------------------|---------------------|----------------------------------------|-------------|--------------------------|-----------------|---------------------------|-------------------------------------------------|------------------|-------------------------------|---------|--------------|---------------------------------------------------------|
|                                                                                   |                     |                                        |             | BIDDER/ :<br>VENDOR      |                 |                           | QUALITY PLAN<br>NUMBER PED-506-00-Q-007, REV-03 |                  | SPECIFICATION :<br>TITLE      |         |              |                                                         |
|                                                                                   |                     | SHEET 6 OF 9                           |             | SYSTEM                   |                 |                           | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)  |                  |                               | SECTION |              | VOLUME III                                              |
| SL. NO.                                                                           | COMPONENT/OPERATION | CHARACTERISTIC CHECK                   | CAT.        | TYPE/<br>METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT        | ACCEPTANCE NORM                                 | FORMAT OF RECORD | AGENCY                        |         |              | REMARKS                                                 |
|                                                                                   |                     |                                        |             |                          |                 |                           |                                                 |                  | P                             | W       | V            |                                                         |
| 1                                                                                 | 2                   | 3                                      | 4           | 5                        | 6               | 7                         | 8                                               | 9                | 10                            |         |              | 11                                                      |
| 2.4                                                                               | SHEET STACKING      | 1.COMPLETENESS                         | MA          | MEASUREMENT              | SAMPLE          | MANUFR'S SPEC.            | MANUFR'S SPEC.                                  | Log Book         | 2                             | -       | -            | (FOR MOTORS OF 2MW AND ABOVE)<br>* ON 10% RANDOM SAMPLE |
|                                                                                   |                     | 2.COMPRESSION & TIGHTENING             | MA          | MEASUREMENT              | 100%            | -DO-                      | -DO-                                            | Log Book         | 2                             | -       | -            |                                                         |
|                                                                                   |                     | 3.CORE LOSS & HOTSPOT                  | MA          | ELECT.TEST               | -DO-            | -DO-                      | -DO-                                            | Log Book         | 2                             | 1*      | 1            |                                                         |
| 2.5                                                                               | WINDING             | 1.COMPLETENESS                         | CR          | VISUAL                   | 100%            | MANUFR'S SPEC./BHEL SPEC. | MANUFR'S SPEC./BHEL SPEC.                       | Log Book         | 2                             | -       | -            |                                                         |
|                                                                                   |                     | 2.CLEANLINESS                          | CR          | -DO-                     | -DO-            | -DO-                      | -DO-                                            | Log Book         | 2                             | -       | -            |                                                         |
|                                                                                   |                     | 3.IR-HV-IR                             | CR          | ELECT. TEST              | -DO-            | -DO-                      | -DO-                                            | Log Book         | 2                             | -       | 1            |                                                         |
|                                                                                   |                     | 4.RESISTANCE                           | CR          | -DO-                     | -DO-            | -DO-                      | -DO-                                            | Log Book         | 2                             | -       | 1            |                                                         |
|                                                                                   |                     | 5.INTERTURN INSULATION                 | CR          | -DO-                     | -DO-            | -DO-                      | -DO-                                            | Log Book         | 2                             | -       | -            |                                                         |
|                                                                                   |                     | 6.SURGE WITH STAND AND TAN. DELTA TEST | CR          | -DO-                     | -DO-            | -DO-                      | -DO-                                            | Log Book         | 2                             | -       | 1            |                                                         |
|                                                                                   |                     |                                        |             |                          |                 |                           |                                                 |                  |                               |         | FOR MV MOTOR |                                                         |
| 2.6                                                                               | IMPREGNATION        | 1.VISCOSCITY                           | MA          | PHY. TEST                | AT STARTING     | -DO-                      | -DO-                                            | Log Book         | 2                             | -       | -            | THREE DIPS TO BE GIVEN                                  |
|                                                                                   |                     | 2.TEMP. PRESSURE VACCUM                | MA          | PROCESS CHECK            | CONTINUOUS      | -DO-                      | -DO-                                            | Log Book         | 2                             | -       | -            |                                                         |
|                                                                                   |                     | 3.NO. OF DIPS                          | MA          | -DO-                     | -DO-            | -DO-                      | -DO-                                            | Log Book         | 2                             | -       | 1            |                                                         |
| BHEL                                                                              |                     |                                        | PARTICULARS |                          |                 | BIDDER/VENDOR             |                                                 |                  |                               |         |              |                                                         |
|                                                                                   |                     |                                        | NAME        |                          |                 |                           |                                                 |                  |                               |         |              |                                                         |
|                                                                                   |                     |                                        | SIGNATURE   |                          |                 |                           |                                                 |                  |                               |         |              |                                                         |
|                                                                                   |                     |                                        | DATE        |                          |                 |                           |                                                 |                  |                               |         |              |                                                         |
|                                                                                   |                     |                                        |             |                          |                 |                           |                                                 |                  | BIDDER'S/VENDORS COMPANY SEAL |         |              |                                                         |



|  |                                      | QUALITY PLAN                                                   |             | CUSTOMER :            |                       |                       | PROJECT TITLE                                  |                  | SPECIFICATION : NUMBER : |   |            |                                |    |
|-----------------------------------------------------------------------------------|--------------------------------------|----------------------------------------------------------------|-------------|-----------------------|-----------------------|-----------------------|------------------------------------------------|------------------|--------------------------|---|------------|--------------------------------|----|
|                                                                                   |                                      |                                                                |             | BIDDER/ VENDOR :      |                       |                       | QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03   |                  | SPECIFICATION : TITLE    |   |            |                                |    |
|                                                                                   |                                      | SHEET 7 OF 9                                                   |             | SYSTEM                |                       |                       | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV) |                  | SECTION                  |   | VOLUME III |                                |    |
| SL. NO.                                                                           | COMPONENT/OPERATION                  | CHARACTERISTIC CHECK                                           | CAT.        | TYPE/ METHOD OF CHECK | EXTENT OF CHECK       | REFERENCE DOCUMENT    | ACCEPTANCE NORM                                | FORMAT OF RECORD | AGENCY                   |   |            | REMARKS                        |    |
| 1                                                                                 | 2                                    | 3                                                              | 4           | 5                     | 6                     | 7                     | 8                                              | 9                | 10                       | P | W          | V                              | 11 |
| 2.7                                                                               | COMPLETE STATOR ASSEMBLY             | 4.DURATION                                                     | MA          | -DO-                  | -DO-                  | -DO-                  | -DO-                                           | Log Book         | 2                        | - | 1          | VERIFICATION FOR MV MOTOR ONLY |    |
| 2.8                                                                               | BRAZING/COMPRESSION JOINT            | 1.COMPACTNESS & CLEANLINESS                                    | MA          | VISUAL                | 100%                  | -DO-                  | -DO-                                           | Log Book         | 2                        | - | -          |                                |    |
| 2.9                                                                               | COMPLETE ROTOR ASSEMBLY              | 1.COMPLETENESS                                                 | CR          | -DO-                  | -DO-                  | -DO-                  | -DO-                                           | Log Book         | 2                        | - | -          |                                |    |
|                                                                                   |                                      | 2.SOUNDNESS                                                    | CR          | MALLET TEST & UT      | -DO-                  | -DO-                  | -DO-                                           | Log Book         | 2                        |   | 1          |                                |    |
|                                                                                   |                                      | 3.HV                                                           | MA          | ELECT. TEST           | -DO-                  | -DO-                  | -DO-                                           | Log Book         | 2                        |   | 1          |                                |    |
| 2.10                                                                              | ASSEMBLY                             | 1.RESIDUAL UNBALANCE                                           | CR          | DYN. BALANCE          | -DO-                  | MFG SPEC./ ISO 1940   | MFG. DWG.                                      | Log Book         | 2                        |   | 1          |                                |    |
|                                                                                   |                                      | 2.SOUNDNESS OF DIE CASTING                                     | CR          | ELECT. (GROWLER TEST) | -DO-                  | MFG. SPEC.            | MFG. SPEC.                                     | Log Book         | 2                        |   | 1          |                                |    |
|                                                                                   |                                      | 1.ALIGNMENT                                                    | MA          | MEAS.                 | -DO-                  | -DO-                  | -DO-                                           | Log Book         | 2                        | - | -          |                                |    |
|                                                                                   |                                      | 2.WORKMANSHIP                                                  | MA          | VISUAL                | -DO-                  | -DO-                  | -DO-                                           | Log Book         | 2                        | - | -          |                                |    |
|                                                                                   |                                      | 3.AXIAL PLAY                                                   | MA          | MEAS.                 | -DO-                  | -DO-                  | -DO-                                           | Log Book         | 2                        | - | 1          |                                |    |
|                                                                                   |                                      | 4.DIMENSIONS                                                   | MA          | -DO-                  | -DO-                  | MFG.DRG./ MFG SPEC.   | MFG. DRG/ RELEVANT IS                          | Log Book         | 2                        | - | -          |                                |    |
|                                                                                   |                                      | 5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE | MA          | VISUAL                | 100%                  | MFG SPEC. RELEVANT IS | MFG SPEC. RELEVANT IS                          | Log Book         | 2                        | - | -          |                                |    |
|                                                                                   | 6. RTD, BTD & SPACE HEATER MOUNTING. | MA                                                             | VISUAL      | 100%                  | MFG SPEC. RELEVANT IS | MFG SPEC. RELEVANT IS | Log Book                                       | 2                |                          | 1 |            |                                |    |
| BHEL                                                                              |                                      |                                                                | PARTICULARS |                       | BIDDER/VENDOR         |                       |                                                |                  |                          |   |            |                                |    |
|                                                                                   |                                      |                                                                | NAME        |                       |                       |                       |                                                |                  |                          |   |            |                                |    |
|                                                                                   |                                      |                                                                | SIGNATURE   |                       |                       |                       |                                                |                  |                          |   |            |                                |    |
|                                                                                   |                                      |                                                                | DATE        |                       |                       |                       |                                                |                  |                          |   |            |                                |    |
|                                                                                   |                                      |                                                                |             |                       |                       |                       |                                                |                  |                          |   |            | BIDDER'S/VENDORS COMPANY SEAL  |    |

|                                                                                   |                     |                                                           |             |                                                |                 |                                |                                       |                  |                               |         |   |                                                              |
|-----------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------|-------------|------------------------------------------------|-----------------|--------------------------------|---------------------------------------|------------------|-------------------------------|---------|---|--------------------------------------------------------------|
|  |                     | <b>QUALITY PLAN</b>                                       |             | CUSTOMER :                                     |                 | PROJECT                        |                                       |                  | SPECIFICATION :               |         |   |                                                              |
|                                                                                   |                     |                                                           |             | BIDDER/ :                                      |                 | TITLE                          |                                       |                  | NUMBER :                      |         |   |                                                              |
|                                                                                   |                     | SHEET 8 OF 9                                              |             | VENDOR                                         |                 | QUALITY PLAN                   |                                       |                  | SPECIFICATION :               |         |   |                                                              |
|                                                                                   |                     | SYSTEM                                                    |             | NUMBER PED-506-00-Q-007, REV-03                |                 |                                | TITLE                                 |                  |                               | SECTION |   |                                                              |
|                                                                                   |                     |                                                           |             | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV) |                 |                                | VOLUME III                            |                  |                               |         |   |                                                              |
| SL. NO.                                                                           | COMPONENT/OPERATION | CHARACTERISTIC CHECK                                      | CAT.        | TYPE/METHOD OF CHECK                           | EXTENT OF CHECK | REFERENCE DOCUMENT             | ACCEPTANCE NORM                       | FORMAT OF RECORD | AGENCY                        |         |   | REMARKS                                                      |
|                                                                                   |                     |                                                           |             |                                                |                 |                                |                                       |                  | P                             | W       | V |                                                              |
| 1                                                                                 | 2                   | 3                                                         | 4           | 5                                              | 6               | 7                              | 8                                     | 9                | 10                            |         |   | 11                                                           |
| 3.0                                                                               | TESTS               | 1. TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.   | MA          | ELECT. TEST                                    | 1/TYPE/SIZE     | IS-325/ BHEL SPEC./ DATA SHEET | IS-325/ BHEL SPEC./ DATA SHEET        | TEST REPORT      | 2                             | 1*      | 1 | * NOTE - 1                                                   |
|                                                                                   |                     | 2. ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC. | MA          | -DO-                                           | 100%            | -DO-                           | -DO-                                  | -DO-             | 2                             | 1\$     | 1 | \$ NOTE - 2                                                  |
|                                                                                   |                     | 3. VIBRATION & NOISE LEVEL                                | MA          | -DO-                                           | 100%            | IS-12075 & IS-12065            | IS-12075 & IS-12065                   | -DO-             | 2                             | 1\$     | 1 | \$ NOTE - 2                                                  |
|                                                                                   |                     | 4. OVERALL DIMENSIONS AND ORIENTATION                     | MA          | MEASUREMENT & VISUAL                           | 100%            | APPROVED DRG/DATA SHEET        | APPROVED DRG/DATA SHEET & RELEVANT IS | INSPC. REPORT    | 2                             | 1       | - |                                                              |
|                                                                                   |                     | 5. DEGREE OF PROTECTION                                   | MA          | ELECT. & MECH. TEST                            | 1/TYPE/ SIZE    | RELEVANT IS                    | BHEL SPEC. AND DATA SHEET             | TC               | 2                             | -       | 1 | TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3              |
|                                                                                   |                     | 6. MEASUREMENT OF RESISTANCE OF RTD & BTD                 | MA          | -DO-                                           | 100%            | -DO-                           | -DO-                                  | -DO-             | 2                             | 1\$     | 1 | \$ NOTE - 2                                                  |
|                                                                                   |                     | 7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER          | MA          | -DO-                                           | 100%            | -DO-                           | -DO-                                  | -DO-             | 2                             | 1\$     | 1 | \$ NOTE - 2                                                  |
|                                                                                   |                     | 8. NAMEPLATE DETAILS                                      | MA          | VISUAL                                         | 100%            | IS-325 & DATA SHEET            | IS-325 & DATA SHEET                   | INSPC. REPORT    | 2                             | 1\$     | 1 | \$ NOTE - 2                                                  |
|                                                                                   |                     | 9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED)              | MA          | EXPLOSION FLAME PROOF TEST                     | 1/TYPE          | IS-3682 IS-8239 IS-8240        | IS-3682 IS-8239 IS-8240               | TC               | 2                             | -       | 1 | TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3              |
|                                                                                   |                     | 10. PAINT SHADE, THICKNESS & FINISH                       | MA          | VISUAL & MEASUREMENT BY ELKOMETER              | SAMPLE          | BHEL SPEC. & DATA SHEET        | BHEL SPEC. & DATA SHEET               | TC               | 2                             | 1\$     | 1 | SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2 |
| BHEL                                                                              |                     |                                                           | PARTICULARS |                                                |                 | BIDDER/VENDOR                  |                                       |                  |                               |         |   |                                                              |
|                                                                                   |                     |                                                           | NAME        |                                                |                 |                                |                                       |                  |                               |         |   |                                                              |
|                                                                                   |                     |                                                           | SIGNATURE   |                                                |                 |                                |                                       |                  |                               |         |   |                                                              |
|                                                                                   |                     |                                                           | DATE        |                                                |                 |                                |                                       |                  | BIDDER'S/VENDORS COMPANY SEAL |         |   |                                                              |



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     | <b>QUALITY PLAN</b>  |             | CUSTOMER :           |                 | PROJECT<br>TITLE                                |                 | SPECIFICATION :<br>NUMBER : |                                                               |            |  |                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|-------------|----------------------|-----------------|-------------------------------------------------|-----------------|-----------------------------|---------------------------------------------------------------|------------|--|-------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |             | BIDDER/ :<br>VENDOR  |                 | QUALITY PLAN<br>NUMBER PED-506-00-Q-007, REV-03 |                 | SPECIFICATION :<br>TITLE    |                                                               |            |  |                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     | SHEET 9 OF 9         |             | SYSTEM               |                 | ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)  |                 | SECTION                     |                                                               | VOLUME III |  |                               |
| SL. NO.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | COMPONENT/OPERATION | CHARACTERISTIC CHECK | CAT.        | TYPE/METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT                              | ACCEPTANCE NORM | FORMAT OF RECORD            | AGENCY<br><div> <div>P</div> <div>W</div> <div>V</div> </div> |            |  | REMARKS                       |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2                   | 3                    | 4           | 5                    | 6               | 7                                               | 8               | 9                           | 10                                                            |            |  | 11                            |
| <p>NOTES:</p> <p>1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.</p> <p>2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.</p> <p>3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.</p> <p>4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER<br/>2. VENDOR (MOTOR MANUFACTURER)<br/>3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</p> <p>P. PERFORM<br/>W. WITNESS<br/>V. VERIFY</p> |                     |                      |             |                      |                 |                                                 |                 |                             |                                                               |            |  |                               |
| BHEL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      | PARTICULARS |                      | BIDDER/VENDOR   |                                                 |                 |                             |                                                               |            |  |                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      | NAME        |                      |                 |                                                 |                 |                             |                                                               |            |  |                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      | SIGNATURE   |                      |                 |                                                 |                 |                             |                                                               |            |  |                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      | DATE        |                      |                 |                                                 |                 |                             |                                                               |            |  |                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                      |             |                      |                 |                                                 |                 |                             |                                                               |            |  | BIDDER'S/VENDORS COMPANY SEAL |



TITLE:  
**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**  
  
**STANDARD TECHNICAL REQUIREMENTS**

SPEC. NO.: **PE-TS-426-100-N002**  
SECTION: **II**  
SUB-SECTION: **IIC**  
REV. NO. **0** DATE 07.02.2020  
SHEET **1** OF **1**

**SUB-SECTION - IIC**

**STANDARD TECHNICAL SPECIFICATION (C &I)**



STD QUALITY PLAN NO.: PE-QP-999-145-I056

|        |     |
|--------|-----|
| VOLUME | IIB |
|--------|-----|

11B

SECTION

D

REV. NO.

01

DATE: 22-02-2008

SHEET

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1

OF

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7

LEGEND: \* CR - Critical characteristics  
MA - Major characteristics  
MI - Minor characteristics

\$

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

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



STD QUALITY PLAN NO.: PE-QP-999-145-I056

|        |     |
|--------|-----|
| VOLUME | IIB |
|--------|-----|

11B

SECTION

D

REV. NO.

01

DATE: 22-02-2008

SHEET

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2

OF

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7

| Sl. No.                                                                                                                                                                                                                                                              | Component / operation                                                                                                                           | Characteristics Checked                                     | * Category     | Type/Method of Check                | Extent of Check      | Reference documents              | Acceptance Norms                 | Format of Records | Agency <sup>s</sup> |     |     | Remarks                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|----------------|-------------------------------------|----------------------|----------------------------------|----------------------------------|-------------------|---------------------|-----|-----|---------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                      |                                                                                                                                                 |                                                             |                |                                     |                      |                                  |                                  |                   | P                   | W   | V   |                                                                                       |
|                                                                                                                                                                                                                                                                      |                                                                                                                                                 | 3. Conductor<br>a) Resistance<br>b) Size<br>c) Sheet colour | MA<br>MA<br>MA | Electrical<br>Measurement<br>Visual | 100%<br>100%<br>100% | BHEL Spec. and Relevant standard | BHEL Spec. and Relevant standard | Log Book          | 2                   | --- | --- |                                                                                       |
|                                                                                                                                                                                                                                                                      |                                                                                                                                                 | 4. Type / Routine Test Certificates                         | MA             | Verification                        | 100%                 | BHEL Spec. and Relevant standard | BHEL Spec. and Relevant standard | Log Book          | 3                   | --- | 2   |                                                                                       |
| 4.0                                                                                                                                                                                                                                                                  | Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc. | 1. Verification at make and Type                            | CR             | Visual                              | Sample               | BHEL Spec. and BOM               | BHEL Spec. and BOM               | Log Book          | 2                   | --- | --- | + for relay & contactors only<br><br>@ for all components except relays & contactors. |
|                                                                                                                                                                                                                                                                      |                                                                                                                                                 | 2. Verification of Test Certificates                        | CR             | Scrutiny of Type / Routine T.Cs.    | 100%                 | Relevant standard                | Relevant standard                | Log Book          | 2                   | --- | --- |                                                                                       |
|                                                                                                                                                                                                                                                                      |                                                                                                                                                 | 3. Operation / Functional check                             | CR             | Electrical                          | Sample+ 100%@        | Relevant standard & Catalogue    | Relevant standard & Catalogue    | Log Book          | 2                   | --- | --- |                                                                                       |
|                                                                                                                                                                                                                                                                      |                                                                                                                                                 | 4. I.R.                                                     | MA             | Electrical                          | 100%                 | Relevant standard & Catalogue    | Relevant standard & Catalogue    | Log Book          | 2                   | --- | --- |                                                                                       |
|                                                                                                                                                                                                                                                                      |                                                                                                                                                 | 5. H.V.                                                     | MA             | Electrical                          | 100%                 | Relevant standard & Catalogue    | Relevant standard & Catalogue    | Log Book          | 2                   | --- | --- |                                                                                       |
|                                                                                                                                                                                                                                                                      |                                                                                                                                                 | 6. Calibration                                              | MA             | Electrical                          | 100%                 | Relevant standard & Catalogue    | Relevant standard & Catalogue    | Log Book          | 2                   | --- | 1   |                                                                                       |
|                                                                                                                                                                                                                                                                      |                                                                                                                                                 | 7. Pick up / Drop off Voltage                               | MA             | Electrical                          | 100%                 | Relevant standard & Catalogue    | Relevant standard & Catalogue    | Log Book          | 2                   | --- | --- |                                                                                       |
| LEGEND: * CR - Critical characteristics<br>MA - Major characteristics<br>MI - Minor characteristics<br><sup>s</sup> P - Agency Performing the Test.<br>W - Agency Witnessing the Test.<br>V - Agency Verifying the Test.<br>1 - BHEL<br>2 - Vendor<br>3 - Sub-vendor |                                                                                                                                                 |                                                             |                |                                     |                      |                                  |                                  |                   |                     |     |     |                                                                                       |



## STD QUALITY PLAN NO.: PE-QP-999-145-I056

VOLUME IIB

IIB

SECTION

D

RFV NO.

01

DATE: 22-02-2008

SHEET

3

OF

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7

| Sl. No. | Component / operation                                      | Characteristics Checked          | * Category | Type/Method of Check | Extent of Check | Reference documents            | Acceptance Norms               | Format of Records | Agency <sup>\$</sup> |     |          | Remarks |
|---------|------------------------------------------------------------|----------------------------------|------------|----------------------|-----------------|--------------------------------|--------------------------------|-------------------|----------------------|-----|----------|---------|
|         |                                                            |                                  |            |                      |                 |                                |                                |                   | P                    | W   | V        |         |
| 5.0     | Misc. Components like <b>Gaskets, Terminal Blocks etc.</b> | 1. Verification of Type / Make   | MA         | Visual               | Sample          | BHEL Spec. & Mfrs. Catalogue   | BHEL Spec. & Mfrs. Catalogue   | Log Book          | 2                    | --- | ---      |         |
|         |                                                            | 2. Surface defects               | MA         | Visual               | Sample          | BHEL Spec. & Mfrs. Catalogue   | BHEL Spec. & Mfrs. Catalogue   | Log Book          | 2                    | --- | ---      |         |
|         |                                                            | 3. IR / HV on Terminal Blocks    | MA         | Electrical           | Sample          | BHEL Spec. & Mfrs. Catalogue   | BHEL Spec. & Mfrs. Catalogue   | Log Book          | 2                    | --- | ---      |         |
| 6.0     | <b>IN PROCESS</b><br>Blanking / Bending / Forming          | 1. Dimensions                    | MI         | Measurement          | 100%            | Approved Mfr. drgs.            | Approved Mfr. drgs.            | Log Book          | 2                    | --- | ---      |         |
|         |                                                            | 2. Surface defects after bending | MA         | Visual               | 100%            | <b>Factory Standard</b>        | <b>Factory Standard</b>        | Log Book          | 2                    | --- | ---      |         |
| 7.0     | Nibbling / Punching                                        | 1. Cutout Sizes                  | MI         | Measurement          | 100%            | Approved Mfr. drgs.            | Approved Mfr. drgs.            | Log Book          | 2                    | --- | ---      |         |
|         |                                                            | 2. Deburring                     | MA         | Visual               | 100%            | Approved Mfr. drgs.            | Approved Mfr. drgs.            | Log Book          | 2                    | --- | ---      |         |
| 8.0     | <b>ASSEMBLY</b><br>Frame Assembly & Sheet fixing           | 1. Dimensions                    | MA         | Measurement          | 100%            | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book          | 2                    | --- | <b>2</b> |         |
|         |                                                            | 2. Alignment                     | MA         | Measurement          | 100%            | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book          | 2                    | --- | <b>2</b> |         |
|         |                                                            | 3. Welding Quality               | MA         | Visual               | 100%            | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book          | 2                    | --- | <b>2</b> |         |
|         |                                                            | 4. Surface defects               | MA         | Visual               | 100%            | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book          | 2                    | --- | <b>2</b> |         |

LEGEND: \* CR - Critical characteristics  
MA - Major characteristics  
MI - Minor characteristics

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W - Agency Witnessing the Test.  
V - Agency Verifying the Test.

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

| <div></div> <div>PEM :: C&amp;I</div> |                            | STANDARD QUALITY PLAN<br>FOR<br>LOCAL CONTROL PANEL        |             |                                                                                                         |                 |                                      |                                      | STD QUALITY PLAN NO.: PE-QP-999-145-I056 |                      |     |   |         |
|------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------|-----------------|--------------------------------------|--------------------------------------|------------------------------------------|----------------------|-----|---|---------|
|                                                                                                                        |                            |                                                            |             |                                                                                                         |                 |                                      |                                      | VOLUME IIB                               |                      |     |   |         |
|                                                                                                                        |                            |                                                            |             |                                                                                                         |                 |                                      |                                      | SECTION D                                |                      |     |   |         |
|                                                                                                                        |                            |                                                            |             |                                                                                                         |                 |                                      |                                      | REV. NO. 01 DATE: 22-02-2008             |                      |     |   |         |
|                                                                                                                        |                            |                                                            |             |                                                                                                         |                 |                                      |                                      | SHEET 4 OF 7                             |                      |     |   |         |
| Sl. No.                                                                                                                | Component / operation      | Characteristics Checked                                    | * Cate gory | Type/Method of Check                                                                                    | Extent of Check | Reference documents                  | Acceptance Norms                     | Format of Records                        | Agency <sup>\$</sup> |     |   | Remarks |
|                                                                                                                        |                            |                                                            |             |                                                                                                         |                 |                                      |                                      |                                          | P                    | W   | V |         |
| 9.0                                                                                                                    | Pre-treatment and Painting | 1. Pretreatment Process                                    | MA          | Visual                                                                                                  | 100%            | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book                                 | 2                    | --- | 1 |         |
|                                                                                                                        |                            | 2. Process parameters like bath temp. concentration etc.   | MA          | Measurement                                                                                             | Periodic        | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book                                 | 2                    | --- | 1 |         |
|                                                                                                                        |                            | 3. Dipping / Removal Time                                  | MA          | Measurement                                                                                             | 100%            | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book                                 | 2                    | --- | 1 |         |
|                                                                                                                        |                            | 4. Surface quality after every dip                         | MA          | Visual                                                                                                  | 100%            | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book                                 | 2                    | --- | 1 |         |
|                                                                                                                        |                            | 5. Primer after phosphating                                | MA          | Visual, Thickness                                                                                       | 100%            | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book                                 | 2                    | --- | 1 |         |
|                                                                                                                        |                            | 6. Putty Application & Rubbing after primer                | MA          | Visual                                                                                                  | 100%            | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book                                 | 2                    | --- | 1 |         |
|                                                                                                                        |                            | 7. Paint first coat                                        | MA          | Visual, Thickness                                                                                       | 100%            | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book                                 | 2                    | --- | 1 |         |
|                                                                                                                        |                            | 8. Putty Application and Rubbing after first coat of paint | MA          | Visual                                                                                                  | 100%            | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book                                 | 2                    | --- | 1 |         |
|                                                                                                                        |                            | 9. Paint second coat                                       | MA          | Visual, Thickness, Scratch test Colour adhesion                                                         | 100%            | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book                                 | 2                    | --- | 1 |         |
| LEGEND: * CR - Critical characteristics<br>MA - Major characteristics<br>MI - Minor characteristics                    |                            |                                                            |             |                                                                                                         |                 |                                      |                                      |                                          |                      |     |   |         |
|                                                                                                                        |                            |                                                            |             | \$ P - Agency Performing the Test.<br>W - Agency Witnessing the Test.<br>V - Agency Verifying the Test. |                 |                                      |                                      | 1 - BHEL<br>2 - Vendor<br>3 - Sub-vendor |                      |     |   |         |



| <br>PEM :: C&I |                                  | STANDARD QUALITY PLAN<br>FOR<br>LOCAL CONTROL PANEL                                               |            |                      |                 |                              |                              |                   | STD QUALITY PLAN NO.: <b>PE-QP-999-145-I056</b> |     |                         |                                                                 |
|-------------------------------------------------------------------------------------------------|----------------------------------|---------------------------------------------------------------------------------------------------|------------|----------------------|-----------------|------------------------------|------------------------------|-------------------|-------------------------------------------------|-----|-------------------------|-----------------------------------------------------------------|
|                                                                                                 |                                  |                                                                                                   |            |                      |                 |                              |                              |                   | VOLUME IIB                                      |     |                         |                                                                 |
|                                                                                                 |                                  |                                                                                                   |            |                      |                 |                              |                              |                   | SECTION D                                       |     |                         |                                                                 |
|                                                                                                 |                                  |                                                                                                   |            |                      |                 |                              |                              |                   | REV. NO. <b>01</b>                              |     | DATE: <b>22-02-2008</b> |                                                                 |
|                                                                                                 |                                  |                                                                                                   |            |                      |                 |                              |                              |                   | SHEET 5                                         |     | OF 7                    |                                                                 |
| Sl. No.                                                                                         | Component / operation            | Characteristics Checked                                                                           | * Category | Type/Method of Check | Extent of Check | Reference documents          | Acceptance Norms             | Format of Records | Agency <sup>\$</sup>                            |     |                         | Remarks                                                         |
|                                                                                                 |                                  |                                                                                                   |            |                      |                 |                              |                              |                   | P                                               | W   | V                       |                                                                 |
| 10.                                                                                             | Panel Wiring                     | 1. Wiring Layout                                                                                  | MA         | Visual               | 100%            | Approved drgs. & Specs.      | Approved drgs. & Specs.      | Log Book          | 2                                               | --- | ---                     |                                                                 |
|                                                                                                 |                                  | 2. Wiring Termination (Crimped Lugs)                                                              | MA         | Visual               | 100%            | Approved drgs. & Specs.      | Approved drgs. & Specs.      | Log Book          | 2                                               | --- | ---                     |                                                                 |
|                                                                                                 |                                  | 3. Ferrule numbers                                                                                | MA         | Visual               | 100%            | Approved drgs. & Specs.      | Approved drgs. & Specs.      | Log Book          | 2                                               | --- | ---                     |                                                                 |
|                                                                                                 |                                  | 4. Colour of wiring                                                                               | MA         | Visual               | 100%            | Approved drgs. & Specs.      | Approved drgs. & Specs.      | Log Book          | 2                                               | --- | 1                       |                                                                 |
|                                                                                                 |                                  | 5. Size of Conductor                                                                              | MA         | Measurement          | 100%            | Approved drgs. & Specs.      | Approved drgs. & Specs.      | Log Book          | 2                                               | --- | 1                       |                                                                 |
| 11.                                                                                             | Component Mounting               | 1. Correct components                                                                             | MA         | Visual               | 100%            | Approved drgs., Specs. & BOM | Approved drgs., Specs. & BOM | Log Book          | 2                                               | --- | ---                     |                                                                 |
|                                                                                                 |                                  | 2. Fixing                                                                                         | MA         | Visual               | 100%            | Approved drgs., Specs. & BOM | Approved drgs., Specs. & BOM | Log Book          | 2                                               | --- | ---                     |                                                                 |
| 12.                                                                                             | <b>FINAL</b><br>Final Inspection | 1. Workmanship                                                                                    | MA         | Visual               | 100%            | Factory Standard             | Factory Standard             | Inspection Report | 2                                               | 1   | 1                       | At Random by BHEL, based on 100 % internal test reports by Mfr. |
|                                                                                                 |                                  | 2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components | MA         | Visual               | 100%            | BHEL approved drg. / Spec.   | BHEL approved drg. / Spec.   | Inspection Report | 2                                               | 1   | 1                       |                                                                 |
|                                                                                                 |                                  | 3. Components identification Marking / Name plates                                                | MA         | Visual               | 100%            | BHEL approved drg. / Spec.   | BHEL approved drg. / Spec.   | Inspection Report | 2                                               | 1   | 1                       |                                                                 |

LEGEND: \* CR - Critical characteristics  
MA - Major characteristics  
MI - Minor characteristics

<sup>\$</sup> P - Agency Performing the Test.  
W - Agency Witnessing the Test.  
V - Agency Verifying the Test.

1 - BHEL  
2 - Vendor  
3 - Sub-vendor

|  <p>PEM :: C&amp;I</p> |                       | <p align="center"><b>STANDARD QUALITY PLAN<br/>FOR<br/>LOCAL CONTROL PANEL</b></p> |            |                      |                 |                                 |                                 | STD QUALITY PLAN NO.: <b>PE-QP-999-145-I056</b> |                      |                         |   |                                                                 |
|---------------------------------------------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------|------------|----------------------|-----------------|---------------------------------|---------------------------------|-------------------------------------------------|----------------------|-------------------------|---|-----------------------------------------------------------------|
|                                                                                                         |                       |                                                                                    |            |                      |                 |                                 |                                 | VOLUME IIB                                      |                      |                         |   |                                                                 |
|                                                                                                         |                       |                                                                                    |            |                      |                 |                                 |                                 | SECTION D                                       |                      |                         |   |                                                                 |
|                                                                                                         |                       |                                                                                    |            |                      |                 |                                 |                                 | REV. NO. <b>01</b>                              |                      | DATE: <b>22-02-2008</b> |   |                                                                 |
|                                                                                                         |                       |                                                                                    |            |                      |                 |                                 |                                 | SHEET 6                                         |                      | OF 7                    |   |                                                                 |
| Sl. No.                                                                                                 | Component / operation | Characteristics Checked                                                            | * Category | Type/Method of Check | Extent of Check | Reference documents             | Acceptance Norms                | Format of Records                               | Agency <sup>\$</sup> |                         |   | Remarks                                                         |
|                                                                                                         |                       |                                                                                    |            |                      |                 |                                 |                                 |                                                 | P                    | W                       | V |                                                                 |
|                                                                                                         |                       | 5. Dimensions                                                                      | MA         | Measurement          | 100%            | BHEL approved drg. / Spec., BOM | BHEL approved drg. / Spec., BOM | Inspection Report                               | 2                    | 1                       | 1 | At Random by BHEL, based on 100 % internal test reports by Mfr. |
|                                                                                                         |                       | 6. Door functioning                                                                | MA         | Functional           | 100%            | BHEL approved drg. / Spec.      | BHEL approved drg. / Spec.      | Inspection Report                               | 2                    | 1                       | 1 |                                                                 |
|                                                                                                         |                       | 7. Paint Shade                                                                     | CR         | Visual               | 100%            | BHEL approved drg. / Spec.      | BHEL approved drg. / Spec.      | Inspection Report                               | 2                    | 1                       | 1 |                                                                 |
|                                                                                                         |                       | 8. Paint Thickness                                                                 | CR         | Measurement          | 100%            | BHEL approved drg. / Spec.      | BHEL approved drg. / Spec.      | Inspection Report                               | 2                    | 1                       | 1 |                                                                 |
|                                                                                                         |                       | 9. Workmanship of Gaskets                                                          | MA         | Visual               | 100%            | Factory Standard                | Factory Standard                | Inspection Report                               | 2                    | 1                       | 1 |                                                                 |
|                                                                                                         |                       | 10. Wiring Layout                                                                  | MA         | Visual               | 100%            | BHEL approved drg.              | BHEL approved drg.              | Inspection Report                               | 2                    | 1                       | 1 |                                                                 |
|                                                                                                         |                       | 11. Wire Termination                                                               | MA         | Pulling manually     | Sample          | -----                           | Firm termination                | Inspection Report                               | 2                    | 1                       | 1 |                                                                 |
|                                                                                                         |                       | 12. Continuity                                                                     | MA         | Electrical           | 100%            | -----                           | Continuity OK                   | Inspection Report                               | 2                    | 1                       | 1 |                                                                 |

|         |      |                            |    |   |                               |   |              |
|---------|------|----------------------------|----|---|-------------------------------|---|--------------|
| LEGEND: | * CR | - Critical characteristics | \$ | P | - Agency Performing the Test. | 1 | - BHEL       |
|         | MA   | - Major characteristics    |    | W | - Agency Witnessing the Test. | 2 | - Vendor     |
|         | MI   | - Minor characteristics    |    | V | - Agency Verifying the Test.  | 3 | - Sub-vendor |
|         |      |                            |    |   |                               |   |              |

| <br>PEM :: C&I |                       | STANDARD QUALITY PLAN<br>FOR<br>LOCAL CONTROL PANEL |            |                      |                 |                                                        |                                                        | STD QUALITY PLAN NO.: <b>PE-QP-999-145-I056</b> |                      |     |   |         |
|-------------------------------------------------------------------------------------------------|-----------------------|-----------------------------------------------------|------------|----------------------|-----------------|--------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------|----------------------|-----|---|---------|
|                                                                                                 |                       |                                                     |            |                      |                 |                                                        |                                                        | VOLUME IIB                                      |                      |     |   |         |
|                                                                                                 |                       |                                                     |            |                      |                 |                                                        |                                                        | SECTION D                                       |                      |     |   |         |
|                                                                                                 |                       |                                                     |            |                      |                 |                                                        |                                                        | REV. NO. <b>01</b> DATE: <b>22-02-2008</b>      |                      |     |   |         |
|                                                                                                 |                       |                                                     |            |                      |                 |                                                        |                                                        | SHEET 7 OF 7                                    |                      |     |   |         |
| Sl. No.                                                                                         | Component / operation | Characteristics Checked                             | * Category | Type/Method of Check | Extent of Check | Reference documents                                    | Acceptance Norms                                       | Format of Records                               | Agency <sup>\$</sup> |     |   | Remarks |
|                                                                                                 |                       |                                                     |            |                      |                 |                                                        |                                                        |                                                 | P                    | W   | V |         |
| 13.                                                                                             | TYPE TEST             | Degree of Protection                                | CR         | Mech. Protection     | Sample          | BHEL approved spec., drg relevant IEC-60947, IEC-60079 | BHEL approved spec., drg relevant IEC-60947, IEC-60079 | Type Test Certificate                           | 3                    | --- | 1 |         |
| 14                                                                                              | ROUTINE TEST          | IR before & after HV Test                           | CR         | Electrical           | 100%            | BHEL approved spec., drg., BOM & relevant standard     | BHEL approved spec., drg., BOM & relevant standard     | Test Report                                     | 2                    | 1   | 1 |         |
| 15                                                                                              | FUNCTIONAL TEST       | 1. Control Logic Operation                          | CR         | Electrical           | 100%            | BHEL approved spec. / drg.                             | BHEL approved spec. / drg.                             | Inspection Report                               | 2                    | 1   | 1 |         |
|                                                                                                 |                       | 2. Instrument Calibration                           | CR         | Electrical           | 10%             | BHEL approved spec. / drg.                             | BHEL approved spec. / drg.                             | Inspection Report                               | 2                    | 1   | 1 |         |
|                                                                                                 |                       | 3. Temperature rise                                 | CR         | Electrical           | 100%            | BHEL approved spec/drg. & relevant standard            | BHEL approved spec/drg & relevant standard             | Inspection Report                               | 2                    | 1   | 1 |         |

LEGEND: \* CR - Critical characteristics  
 MA - Major characteristics  
 MI - Minor characteristics

<sup>\$</sup> P - Agency Performing the Test.  
 W - Agency Witnessing the Test.  
 V - Agency Verifying the Test.

1 - BHEL  
 2 - Vendor  
 3 - Sub-vendor



Technical specification  
for  
**1X660 MW TPS PANKI EXTN.**

REV. NO.

00

DATE : 20.07.2019

# **INSTRUMENTS CHECK LIST**



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

### CHECK LIST FOR LEVEL GAUGE

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

#### Legend :

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

#### Note :

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



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

### CHECK LIST FOR ANNUNCIATORS

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

#### Legend :

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

#### Note :

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



TITLE:  
**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**  
**STANDARD TECHNICAL REQUIREMENTS**

SPEC. NO.: **PE-TS-426-100-N002**  
SECTION: **III**  
SUB-SECTION:  
REV. NO. **0** DATE 07.02.2020  
SHEET **1** OF **1**

### **SECTION III**

**DOCUMENTS TO BE SUBMITTED BY BIDDER**



TITLE:  
**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**  
**STANDARD TECHNICAL REQUIREMENTS**

SPEC. NO.: **PE-TS-426-100-N002**  
SECTION: **III**  
SUB-SECTION:  
REV. NO. **0** DATE 07.02.2020  
SHEET **1** OF **1**

**SECTION IIIA**

**COMPLIANCE CERTIFICATE**

**(TO BE SUBMITTED ALONG WITH BID)**



|                                                                                   |                                                                                        |                                                          |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------|
|  | <b>TITLE : TECHNICAL SPECIFICATION<br/>SUMP PUMPS<br/>1X660 MW PANKI TPS EXTENSION</b> | <b>SPECIFICATION No. :</b><br>PE-TS-426-100-N002, Rev-00 |
|                                                                                   | <b>COMPLIANCE CERTIFICATE</b>                                                          | <b>SECTION: IIIA</b>                                     |
|                                                                                   |                                                                                        | <b>Date: 07.02.2020</b>                                  |
|                                                                                   |                                                                                        | <b>Sheet 1 of 1</b>                                      |

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.
- b) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.
- c) QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.
- d) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/ Customer approval.
- e) Bidder shall include the cost of Mandatory Spares, unless specified otherwise in Sec-IA of the specification or NIT.  
Any mandatory spares stated as not applicable, shall have to be supplied without any cost implication to BHEL in the event they are found to be applicable during detail engineering stage.
- f) There are no other deviation with respect to specification other than those furnished in the 'Schedule of Deviations'.
- g) The offered materials should be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty. All materials shall be subject to approval in the event of order.
- h) Prices for recommended spares (if any) for 3 years operation shall be furnished separately & not included in the base price.
- i) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).
- j) All sub vendors shall be as per BHEL/ Customer approved list.
- k) Any special tools & tackles, if required, shall be in bidder's scope.
- l) All models offered have been supplied by bidder in the past and are meeting the experience qualifying criteria of BHEL/ Customer (viz. The submersible pumps shall be of proven design. The pump manufacturer should have manufactured and supplied at least One (1) no. of submersible pump set for continuous duty for similar application, of type and capacity as offered or higher and which has been in successful operation for at least one (1) year prior to the date of Techno-Commercial bid opening. The pump set shall be suitable for pumping raw water with high turbidity and soft solids/fibrous solids which are generally observed in contaminated rivers / canal water. Components of Identical pumps shall be interchangeable. Any deviation to these criteria shall be suitably highlighted in deviation schedule).
- m) All selected motor ratings have minimum margins as per Data sheet-A, section-1D of technical specification.
- n) Power & Control circuits shall be with MCCB.

We the undersigned hereby undertake to meet the compliance requirements as listed above on the conditions as elsewhere specified.

**PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE**

|      |             |           |      |  |
|------|-------------|-----------|------|--|
| NAME | DESIGNATION | SIGNATURE | DATE |  |
|------|-------------|-----------|------|--|



TITLE:  
**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**  
**STANDARD TECHNICAL REQUIREMENTS**

SPEC. NO.: **PE-TS-426-100-N002**  
SECTION: **III**  
SUB-SECTION:  
REV. NO. **0** DATE 07.02.2020  
SHEET **1** OF **1**

**SECTION IIIB**

**GA DRAWING OF SUMP PUMPS**

**(TO BE SUBMITTED ALONG WITH BID--FOR REF. ONLY)**



TITLE:  
**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**  
**STANDARD TECHNICAL REQUIREMENTS**

SPEC. NO.: **PE-TS-426-100-N002**  
SECTION: **III**  
SUB-SECTION:  
REV. NO. **0**      DATE **07.02.2020**  
SHEET **1**      OF **1**

**SECTION IIIC**

**DEVIATION SCHEDULE  
(AS PER NIT FORMAT)**

**(TO BE SUBMITTED ALONG WITH BID)**



TITLE:  
**TECHNICAL SPECIFICATION FOR  
SUMP PUMPS**  
**STANDARD TECHNICAL REQUIREMENTS**

SPEC. NO.: **PE-TS-426-100-N002**  
SECTION: **III**  
SUB-SECTION:  
REV. NO. **0** DATE 07.02.2020  
SHEET **1** OF **1**

**SECTION IIID**

**ELECTRICAL LOAD DATA FORMAT**

**CABLE SCHEDULE**

**MOTOR DATA SHEET-C**

**AND BLALANCE DOCUMENT AS PER CL. 13.0 OF SECTION-IA**

**(TO BE SUBMITTED BY SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT)**

| LOAD TITLE | RATING (KW / A) |                         | UNIT (U)/STN (S) | Nos.    |         | VOLTAGE CODE* | FEEDER CODE** | EMER. LOAD (Y) | CONT.(C)/ INTT.(I) | STARTING TIME<br>>5 SEC (Y) | LOCATION | BOARD NO. | CABLE     |     | BLOCK CABLE<br>DRG. No. | CONTROL CODE | REMARKS | LOAD No. |
|------------|-----------------|-------------------------|------------------|---------|---------|---------------|---------------|----------------|--------------------|-----------------------------|----------|-----------|-----------|-----|-------------------------|--------------|---------|----------|
|            | NAME PLATE      | MAX. CONT. DEMAND (MCR) |                  | RUNNING | STANDBY |               |               |                |                    |                             |          |           | SIZE CODE | NOs |                         |              |         |          |
| 1          | 2               | 3                       | 4                | 5       | 6       | 7             | 8             | 9              | 10                 | 11                          | 12       | 13        | 14        | 15  | 16                      | 17           | 18      | 19       |

ANNEXURE-II

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|------------------|---------------------------|------------------|---------------|--|--|--------------------|--|---------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|
| NOTES:           |                           |                  |               |  |  |                    |  |         |                   | 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER |  |  |  |  |  |  |  |  |  |
| 2. ABBREVIATIONS |                           |                  |               |  |  |                    |  |         |                   | : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V             |  |  |  |  |  |  |  |  |  |
|                  |                           |                  |               |  |  |                    |  |         |                   | : ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)                    |  |  |  |  |  |  |  |  |  |
|                  | LOAD DATA<br>(ELECTRICAL) | JOB NO.          | 426           |  |  | ORIGINATING AGENCY |  |         | PEM (ELECTRICAL)  |                                                                                                                                                       |  |  |  |  |  |  |  |  |  |
|                  |                           | PROJECT TITLE    | 1X660MW PANKI |  |  | NAME               |  |         | DATA FILLED UP ON |                                                                                                                                                       |  |  |  |  |  |  |  |  |  |
|                  |                           | SYSTEM           | SUMP PUMPS    |  |  | SIGN.              |  |         | DATA ENTERED ON   |                                                                                                                                                       |  |  |  |  |  |  |  |  |  |
|                  |                           | DEPTT. / SECTION | MSE           |  |  | SHEET 1 OF 1       |  | REV. 00 |                   | DE'S SIGN. & DATE                                                                                                                                     |  |  |  |  |  |  |  |  |  |
|                  |                           |                  |               |  |  |                    |  |         |                   |                                                                                                                                                       |  |  |  |  |  |  |  |  |  |

### ANNEXURE III

[illegible]

**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:

(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)

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

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



|                                                                                   |                                                               |                                      |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------|--------------------------------------|
|  | <b>TITLE</b><br><br><b>MOTOR</b><br><br><b>DATA SHEET - C</b> | <b>SPECIFICATION NO.</b>             |
|                                                                                   |                                                               | <b>VOLUME</b> <b>II B</b>            |
|                                                                                   |                                                               | <b>SECTION D</b>                     |
|                                                                                   |                                                               | <b>REV NO. 00    DATE 29/08/2005</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</b> <b>II B</b>            |
|                                                                                   |                                                               | <b>SECTION D</b>                     |
|                                                                                   |                                                               | <b>REV NO. 00    DATE 29/08/2005</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 |      |      |  |